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30 September 1985

# China Report

SCIENCE AND TECHNOLOGY

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NATIONAL DEVELOPMENTS

NI ZHIFU ON SCIENTIFIC, TECHNICAL REFORM

SK300001 Tianjin TIANJIN RIBAO in Chinese 4 Aug 85 pp 1, 3

[Speech by Ni Zhifu, member of the Political Bureau of the CPC Central Committee and secretary of the Tianjin Municipal CPC Committee, given at the municipal work conference on scientific and technological reform on 3 August]

[Text] The work conference on scientific and technological reform has been continuing for 5 days and will be concluded today. The conference has been successful. The participants have conscientiously studied the "Decision of the CPC Central Committee on Reform of the Scientific and Technological Structure," profoundly understood the spirit of the speeches of Comrades Xiaoping and Ziyang and, in line with the actual situation of our municipality, discussed the specific measures for implementation. Comrade Ruihuan and Jingheng already spoke on the major problems to be solved at this conference. We hope that the participants will study and implement the speeches well after returning to their work posts.

Since last October, the CPC Central Committee has formulated three decisions on the reform of the economic, scientific and technological, and educational structures within a short period of 7 months. Based on the principle of integrating the fundamental tenets of Marxism with Chinese practice, the three decisions expound the necessity and urgency of the reform of the economy, science and technology, and education, and explicitly stipulate the orientation, nature, tasks, and basic policies for the reforms in these fields. They are programmatic documents guiding the current reforms. The formulation of these three decisions shows that our party has matured and is capable of solving the many problems in China's socialist construction by applying the fundamental tenets of Marxism in a creative manner. The implementation of these three decisions indicates that reforms have been carried out thoroughly in wider spheres. Through the reforms, we will certainly attain the general goal, which is to enable our country to eliminate poverty to proceed toward prosperity, and to eliminate backwardness to proceed toward modernization and build socialism with Chinese characteristics. The reason why I speak on the ideas repeatedly stressed by the CPC Central Committee is to enable leading comrades at various levels to understand more deeply that reform, as a new revolution, will certainly encounter certain complicated situations that we have not expected. However, no matter how great the difficulty will be, we should unswervingly walk on the road of reform. It is hoped that leading comrades at various levels

will foster this basic belief and conscientiously lead the reforms well in line with the goals defined by the CPC Central Committee. I will speak on the following three opinions.

First, the whole party should fully understand that the modernization of science and technology is the key to the four modernizations, and that it is necessary to open up avenues for scientific and technological achievements to rapidly turn into actual productive forces and for achieving technological progress.

At the 1978 national scientific conference, Comrade Xiaoping gave two famous theories of extreme importance. The first is that science and technology are productive forces, and the second is that the intellectuals of China have become a part of the working class. Now 7 years has passed. Through the practice, the whole party has basically unified its understanding of these two important issues. This is the historical change of the guiding ideology in our country's scientific and technological work, an important policy decision of our party in leading socialist modernization. However, we should note that there are many things to be done in order to further emancipate the scientific and technological productive forces and to further arouse the enthusiasm and creativity of intellectuals. Now that we have unified understanding and have clear principles, we should solve the problems in the structure in the next step. The CPC Central Committee's decision on reform of the scientific and technological structure draws a clear blueprint for us to solve the problems. The basic purpose of the scientific and technological reform is to apply scientific and technological achievements to production rapidly and widely, to give full play to the role of scientific and technical personnel, to greatly emancipate scientific and technological productive forces, and to promote economic and social development. Just as Comrade Xiaoping pointed out: "The new economic structure should be one conducive to technological progress, and the new scientific and technological structure should be one conducive to economic development." We must strengthen party leadership to ensure the achievements of reforms of the economic and scientific and technological structures. We must also straighten out the dialectical relationship between economic construction on the one hand and science and technology on the other in "relying on" and "gearing to." We should regard technological progress as important when developing the economy.

At present, a conspicuous question that economic construction and scientific and technological work are facing is how to turn technological achievements into productive forces as quickly as possible, that is, to turn potential productive forces into actual productive forces. Intellectuals in China are world famous for their diligence and wisdom. Under the leadership of the party, they have achieved great results and scored a great number of technological achievements over the past few years. The situation has been the same in Tianjin. Including the central scientific research units located in Tianjin, our municipality has a contingent of 190,000 scientific and technical personnel. Recently, I visited some representative scientific research and designing units and the research institutes of some universities and colleges. My first impression was that the quality of the basic contingent of Tianjin's scientific and technological front is good and its force is fairly substantial. Scientific and technical personnel have an enterprising and dedicated spirit.

It is commendable that they have achieved great results over the many years under rather poor conditions. Since 1978, 1,100 scientific research achievements have been awarded by our municipality of which some 500 reached the advanced domestic levels of the same trades and some 100 were close to world levels, and 35 important achievements won state invention awards. However, these scientific research achievements are not actual productive forces because coming out of laboratories, scientific research achievements should go through intermediate experiment, improvement of technological process, and designing and production of equipment, to reach steady mass production. Such a course to stabilize technology and production cannot possibly be completed by scientific research units independently. The present situation is that many scientific research personnel have achieved some findings, written theses, and obtained invention certificates but their findings cannot be applied to production to yield due economic results and social effects because the above-mentioned intermediate links cannot be solved. Some comrades said that Tianjin had many "number one" and very few "number two," and the products of its enterprises had remained unchanged for many decades. As everybody knows, China has launched man-made satellites on many occasions, exploded hydrogen and atomic bombs, and successfully produced insulin. Our country has also scored very great achievements in the research and production of important complete sets of equipment. For instance, the large metallurgical equipment of the Panzhihua Steel Plant, the key water conservancy project of the Gezhouba Dam, and the complete sets of production lines of the No 2 Vehicle Plant show that our country is very capable of technological development. In large-scale production technology, however, many new scientific and technological achievements, new technologies and new techniques cannot be popularized effectively and rapidly in industrial and agricultural production and cannot take root, blossom, and bear fruits in the production of enterprises. This problem is one of the obstacles to our rapid progress of the four modernizations. It is precisely to solve these problems and overcome these obstacles that we carry out reform. When we promote the reform of the scientific and technological structure, we should also successfully review our past experiences and lessons. Factors contributing to some of our major successes could be roughly summarized as strengthened planning, macroeconomic coordination, overall control and necessary administrative intervention. I think these are the experiences and lessons we should draw on. Today, we should add another one--to apply the economic levers more voluntarily. Therefore, we are convinced that as long as we make efforts to explore and practice, we will certainly improve the reform of the scientific and technological structure step by step.

The reform of the scientific and technological system is an arduous task of the broad masses of scientific and technological workers in scientific and technological departments. I hope that we will make efforts to achieve greater and faster results in scientific and technological work as well as strive to promote, serve and perfect technology. Links must be closely tightened between production enterprises and the departments for using new products. The invention of new technology, new materials, new parts of appliances, and new products, and the successful production of products on a trial basis is only the starting point. We should make great efforts to open up ways to apply these new things and to expand the scale of applying them. Scientific research institutes should divide work in reasonable and coordinated manners and pay attention to linking applied science with basic theory. We must neither rely only

on experiences to handle affairs or make designs to the neglect of theoretical analysis or essential designs, nor pay only attention to theses to the neglect of the practical application of the theses. We must not be content with making sample products for technological development to the neglect of the process of equipment, or be satisfied with the small amount of trial production to the neglect of the efforts to realize industrialization. The units are not allowed to regard the new products that may create higher economic results as their "door watchers" instead of transferring them to enterprises. Certainly the key to solving these problems is to reform the scientific and technological system. The practices of changing the appropriation system, making technological achievements commercialized, opening technological markets, expanding the decision-making power of scientific and technological units, eliminating barriers between different regions and different departments, developing lateral cooperation, and enhancing the enterprises' capacity in absorbing and developing technology are to turn scientific and technological achievements into real productive forces in a faster and more extensive manner and to ensure a close combination between science and technology and the economy.

Reforming the scientific and technological system should not only be undertaken by scientific and technological departments but also by all departments, all trades and professions, and all enterprises. Practices should [word omitted] that the upgrading and updating of new products, the development and application of new materials and new technology, the technological transformation among traditional industries, and the establishment and development of newly developed industries principally hinge on scientific and technological must rely on the vigorous supports and cooperation of all trades and professions and the departments in all fields.

Industrial and agricultural departments and enterprises should pay much attention to technological progress. We must not be short-sighted, fear dangers, unwillingly apply new technology, or lack enthusiasm for studying and manufacturing new products under the current situation when all production tasks can be fulfilled and all are quite well. We must not only fix our eyes on advanced foreign equipment. But we should persist in the principle of conducting reforms, opening to the outside world, and enlivening domestic economy to import essential technology and equipment to conduct technological transformation. In fact, over the past few years, we have imported several light industrial and daily consumer goods production lines and equipment for producing metallurgical, chemical industrial, and machinery products. However, this only plays an exemplary role in promoting the technological transformation among all trades and professions, but does not mean that we have digested and absorbed them or have blazed new trials by relying on them. The experiences at home and abroad tell us that a big country like ours cannot only rely on foreign exchanges to conduct modernizations. We should encourage industrial and agricultural enterprises and departments to closely integrate themselves with the departments of scientific research, cooperate with these departments to develop new technique and products, to adopt new technology, and to make new sets of equipment; and we should lay a good foundation for ourselves. Efforts should be made to encourage or organize units to set up various types of lateral cooperation (such as cooperation in all fields, on a single item, long or short-term, and a close [jinmi] nature or loose [songsan]), and to organize continuous line of harmonious work. The scientific and technological,

economic, and planning commissions and the departments concerned in charge of comprehensive work should actively do a good job in conducting coordinative, organizational, and service work in an overall way; work out concrete measures in line with the policies on tax revenues, prices, monetary, and personnel affairs; bring into play the lever role of the economy; and should give vigorous support to the programs of technical progress.

Recently, departments across the municipality have earnestly discussed the municipal overall plan and studied the issue of how to formulate the Seventh 5-Year Plan. During the Seventh 5-Year Plan period, we feel that a good job should be done in organizing step by step and in a planned way the contingent of personnel in charge of overcoming technical difficulties among the major five circles, (such as higher educational institutions, the central scientific research institutes, the local scientific research units, the Commission of Science, Technology, and Industry for National Defense, and industrial enterprises), by surmounting the demarcation line among the commission, the bureaus, and the professionals and by aiming at setting up a production system with fine quality, high yield, and low cost in line with the result scored in producing the best salable products and scored by advanced enterprises, at bringing about productive forces on a large scale in line with the opening of new products and new enterprises, at conducting technical renovations among the old key enterprises, and at learning from, popularizing, and creating something new among the imported important production lines and imported technology. We also feel that a good job should be done in harmoniously organizing the technical forces among the links of scientific research, designation, manufacture, utilization, and of production. We are convinced that we will certainly be able to work out some good means and ways for conducting reforms in scientific and technological systems in the course of fulfilling the Seventh 5-Year Plan.

In the industrially-developed countries, some experienced industrialists can immediately go into action in grasping the new technique and new products that have been found by them, that have outstanding characteristics, and that are profitable. They even adopt all means and ways, (such as providing investment and conducting legislation), to establish a set of technical and production system in order to create profits on an extra large scale. In line with the enterprising spirit, why can't the plant chiefs and managers of our enterprises have higher initiative, enthusiasm, and alertness of making technical progress? From my point of view, we, from now on, should establish regulations and rules to regard the true technical progress and the achievements scored in truly turning scientific and technological results into productive forces as an important yardstick in measuring the results of leading work done by the departments and enterprises.

Second, the entire party should strive to bring up the contingent of the working class' personnel in conformity with the four requirements of cadres and to fulfill the program of building the socialist four modernizations.

The interference of historical materialism, "China's intellectuals have become a part of the working class," has given profound enlightenment and encouragement to China's intellectuals and the broad masses of working class.

Intellectuals are a part of the working class who possess more cultural and scientific knowledge and have the clear-cut sense of duty and honor in the new historic period. Therefore, they should all the more study modern science and technology, accelerate the pace of renewing knowledge, and should assume the heavy duty of achieving development in China's science, technology, and economy in order to catch up with or surpass the standard of the advanced world.

Comrade Yaobang has said: "Over the past 60 years or so since its inauguration, our party has mainly led the people of all nationalities throughout the country to engage in two major events. One was to overthrow the old world and the three big mountains; and the other was to build a new world and a modern and powerful socialist country. To overthrow the old world, we needed knowledge and intellectuals; and to build a new world, we all the more needed knowledge and intellectuals." History has already proven and continues to prove this truth to be absolutely correct. The October Revolution brought China Marxism and Leninism. It was just through the spread of revolutionary intellectuals, we armed our entire revolutionary contingent and won a victory in the democratic revolution and the socialist revolution. At present, we need even more intellectuals to spread cultural and scientific knowledge and to improve the cultural and scientific levels of our entire nation. Only by doing so can we realize the socialist four modernizations; otherwise, all will be fruitless. Without knowledge, a contingent of the working class will become an ignorant contingent, will be unable to accept the challenge of the new technical revolution, and will be impossible to fulfill the historical task of building China into a modern and powerful socialist country with a highly developed democracy and civilization. Therefore, we, the working class, should be proud of the increasingly expanded contingent of intellectuals. We should admit that in our current working class, the proportion of intellectuals is not big enough. We should strive to attain the arduous task of expanding the contingent of intellectuals. To attain this task, the broad masses of workers and staff members should strive to study cultural knowledge, technologies, and economic management skills, should study professional and specialized knowledge in line with the need of their jobs, and should master self-taught skills. Meanwhile, intellectuals should earnestly contribute to raising the cultural and scientific levels of the entire working class in the course of raising their own scientific and technological levels. Our country's working class truly has such a fine tradition. Most of our workers have studied revolutionary truth and cultural and scientific knowledge by attending workers' schools (or night schools). Many middle-aged comrades personally experienced that in the 1950's and 1960's, many of our workers and technical cadres became professional by attending sparetime courses. In addition to studying in schools, our workers learned from technical personnel in the course of engaging in production, technical renovation, and technical cooperations. In spite of the existing "leftist" ideas, some workers cooperated and united with technical personnel, learned from each other, and tackled problems together with them. Many workers achieved success in their renovation and creation programs with the help, wisdom, and efforts of technical personnel. Many technical personnel combined theory with practice, learned from workers and practice, and then built themselves into talents both versed in polite letters and martial arts, and both socialist-minded and vocationally proficient.

Just as Comrade Yaobang said, the tendency of underestimating knowledge and looking down on and oppressing intellectuals developed to an absolutely preposterous situation during the "Great Cultural Revolution" period. During that period, the people even regarded the practice of respecting knowledge and intellectuals as a practice of "indulging in revisionism," which would lead to the subjugation of our country and our party. It was just through such an idea which divided the contingent of the working class into the so-called "eldest category" and "the ninth category," and pitted intellectuals against workers.

Today, the CPC Central Committee has reiterated over and over again the need to conscientiously implement the policy on intellectuals. The purpose is to thoroughly eliminate the remaining influence of the "leftist" deviationist mistakes in our ideology, public opinions, and our political, economic, and organizational measures. I think the ultimate purpose should be strengthening the unity of the working class. We should repeatedly make it clear to the working class that intellectuals are a part of the comrades of the working class who have mastered a comparatively large amount of general and scientific knowledge, and that scientific and technical personnel are pioneers of new productive forces. They are shouldering the heavy responsibility of disseminating advanced general and scientific knowledge to the whole society rapidly and with their utmost efforts, and they are standing in the most forward position to meet the challenges of the technological revolution of the new world. They should both be students and teachers, both continuously renew their own knowledge and prepare lessons, and spend more time in training scientific and technical personnel and disseminating knowledge, and both think day and night to draw new design blueprints and realize the blueprints together with other people. These are the tasks entrusted upon them by the historical mission, and also the work they should perform. Therefore, how can we not guarantee them necessary rear services? We should point out that such rear services does not mean preferential treatment to certain persons. It is the need of the socialist four modernizations. It is proceeded from this point that we should solve the problems of specialized technical personnel in returning to the profession they were trained for, the problems of backbone scientific and technical personnel living apart from their spouses, and the "difficulty in joining the party" of some intellectuals. In providing houses, we should give some priority to intellectuals. In essence, this is a matter of improving their work conditions. Although there are many actual difficulties under the current objective conditions, leading persons at various levels should attach importance to them and solve them properly step by step. Wages, bonuses, and professional advanced study are also issued of the same nature. All in all, we should not give empty or big talk, but should solve problems earnestly.

Here, we should also point out that the intellectual contingent of China's working class is one dedicated to the socialist four modernizations. Many outstanding representatives of them are outstanding persons who cherish the motherland and the people, ardently love socialism, have lofty ideals, and face up to adverse circumstances and difficulties with an unshakable will. Many veteran scientists have given up excellent pays, work, and positions and returned from abroad to work with all their might for the scientific and technological progress of the country. Many middle-aged scientific and technical personnel, such as the advanced persons like Jiang Zuying and Comrade Qu Xiao, who is

called a true "horse herder," are working for the communist cause in a down-to-earth manner without considering their personal losses and gains.

We should also note that following the development of the socialist material and spiritual civilizations, more and more workers are acquiring knowledge, the intellectual contingent of the working class is expanding, and the unity of the working class is being strengthened. They are continuously improving their ideological and political awareness and educational standards. We are bringing up a contingent of the working class who has ideals, morality and education, and who abide by discipline.

Comrade Xiaoping also profoundly pointed out that in restructuring science and technology, talented persons are a question he is most concerned about. We should pay attention to arousing the initiative of talented persons of various specialities, and truly organize the great forces. We should strive to create an environment in which the top talented persons can display their talents so that specialized personnel of various fields, including those with professional skills, can fully perform their functions. We should not overlook those talented persons who are not versed in many fields, who are not party members, and who do not have formal schooling, technical titles, or seniority. So long as party leaders at all levels break with the trammels of conventional ideas, and widen their field of vision, talented people will stand before them. In such a big city like Tianjin, the resources of talented people should be very rich. The question is now to let each talented person play a role.

Scientific and technological personnel can be divided into various types, such as experts with profound knowledge, and those with pioneering spirit in management. We should give play to their specialities of these scientific and technological personnel. Those who are in their prime and are good at organizational management should be promoted to leading posts or to key posts for them to guide management work. Those who are making progress in their professional work should not be assigned to administrative work as long as possible. Some special measures should be mapped out to boost the growth of the top-notch talent, including using for reference the experiences of some veteran scientists on becoming professional. We should dare to support the young top-notch talent to show their superior ability. After retreating from the leading posts, those veteran specialists and scientists, if they are very energetic, should be encouraged to conduct scientific research, write books, spread information, serve as advisers, and train new talent. Many of such specialists and scientists have made contributions to our municipality in formulating the overall planning and in studying the measures for meeting the technical revolution of the new world. I hope that such specialists and scientists will continue to play their role in the future in studying how to build Tianjin into a comprehensive industrial base equipped with advanced technologies, how to play the role of an open-style and multifunctional economic center, and how to strengthen the construction of the "three capital" projects. Meanwhile, we should note that among the broad masses of workers lies a great scientific and technical potential. This is an important force not to be ignored in developing scientific and technical undertakings. The activity of organizing technical cooperations among workers has always been

very brisk in Tianjin Municipality. Originally, this activity was initiated by some advanced model persons who organized talent and specialists of various professions and trade to help plants and enterprises tackle problems. Under the support of governments and trade unions, now more than 50,000 people have joined this activity, and a relatively complete system has been formed for conducting technical cooperations. They have frequently launched mass technical renovations and technical improvement activities in light of the key and weak links in production of enterprises, have solved a large number of practical problems in production, and have played a great role in promoting the municipal economic construction. Of the five new technologies and inventions sent by the municipality to the 13th international new technology and inventions exhibition held this year in Geneva, three were produced by technicians and workers of plants. The question of whether or not our leaders at all levels pay attention to the role of workers is in fact the question of whether or not we can adhere to the mass line in developing industrial construction and scientific research work. We should master the method to mobilize thousands upon thousands of workers to promote the development of scientific and technological undertakings.

Third, we should strengthen party leadership, and ensure the smooth development of the scientific and technological structural reform.

In reforming the scientific and technological structure, we should mobilize the large number of masses to participate in the reform, arouse the initiative of all scientific and technical personnel and all intellectuals, give full play to the knowledge and talent of all scientific and technological personnel and all intellectuals, and enable them to make as big contributions to the economic construction as possible. This is the purpose of reforming scientific and technical structure. Leadership work at all levels must be carried out around this purpose. How can we fully mobilize the initiative and creativity of intellectuals? How should we expeditiously solve the problems and difficulties emerged in the course of reform in order to ensure the stable and sound development of reform? I think we should at least grasp the work in the following aspects.

1. We should intensify ideological and political work among intellectuals. The party's ideological and political work has always been the lifeline of our work of various fields. This is particularly true in the new situation of reform and opening up to the outside world. We lack sufficient experience in how to arouse the enthusiasm of intellectuals more successfully and how to conform to and serve the present reform through vivid and lively ideological and political work. We should base ourselves on the needs of the new historical conditions, eliminate outmoded old methods, explore new ways, and create new experiences to make ideological work more realistic and effective.

First, ideological and political work should be carried out during the practice of reform and during scientific experimentation. As reform is a revolution and scientific experimentation is an exploration, obstacles and difficulties are bound to crop up during the process, and people will have different reactions and attitudes toward them. Only by helping and encouraging the people for the purpose of eradicating difficulties, and by analyzing problems and removing the obstacles together with them can we promote our work, enhance

our mutual understanding, and achieve a common language. Second, the starting point of ideological and political work should be placed on showing concern for and serving intellectuals. We should, of course, spend some money to improve the work and living conditions of intellectuals. However, it does not necessarily mean to spend money when we speak on arousing their enthusiasm. Successful ideological and political work will also boost the enthusiasm of intellectuals to a great extent. There are many such cases. Comrade Sun Huanshi, party committee secretary of the Tianjin Municipal Construction Survey and Designing Institute, is a model ideological and political worker. He is a second-class disabled soldier. After he was transferred to the scientific and technological front, he conscientiously studied and understood the party's policy on intellectuals, established profound friendship with intellectuals during his long period of contacts with them, and was regarded by scientific and technical personnel as a "bosom friend." The greatest characteristic of Comrade Sun Huanshi's ideological and political work is his utmost effort to deal with their misgivings and difficulties, and through which to greatly boost the enthusiasm of intellectuals. This institute remarkably fulfilled the surveying and designing tasks for our municipality's key construction projects. If all our party committee secretaries proceed from showing concern for and serving intellectuals in doing the ideological and political work like Comrade Sun Huanshi did, a new situation will appear in our municipality's scientific and technological work. Third, we should become familiar with the people among whom we will carry out ideological and political work. For example, we should understand the specific characteristics of the scientific research labor, familiarize ourselves with the characteristics and mentality of intellectuals, and so on. Just a while ago, I said that intellectuals are enterprising and willing to contribute to the four modernizations with their specialties. With a comparatively stronger sense of self-esteem, they need to be trusted and understood and hope that their achievements of labor will be acknowledged by society. Only when we become familiar with the characteristics of intellectuals can we carry out the ideological work right to the point. Of course, everybody in society should be remolded, and there is no exception with the working class. Intellectuals also have flaws and weak points. We should not demand perfectness. Nor should we turn a blind eye to their flaws and weak points. We should remind them in a timely manner to refrain from "scorning each other," and encourage them to be good at learning from practice and from workers and peasants, and to be modest and prudent, guard against complacency, and be willing to play a supporting role, to unite, and to cooperate. We should help them guard against the corrosive influence of the nonproletarian ideology. Finally, we should urge leading cadres at all levels to make friends with intellectuals. The proletarian revolutionaries of the older generation and the central leading comrades should also make friends with intellectuals. Making friends with intellectuals is one of the important ways for the party to establish ties with intellectuals as well as one of the effective ways for making the ideological and political work of intellectuals successful. Some districts and bureaus in our municipality have established the system of handling the visits of intellectuals and have assigned leading comrades of the CPC Committees to directly hear their reports and opinions. Some districts and bureaus have made it a rule for leading cadres of the CPC Committees to make friends with intellectuals and have achieved beneficial results in this regard. Such way of doing things is worth advocating.

2. We should serve as good directors of the logistics departments. Comrade Xiaoping has said several times that in order to develop China's scientific, technological, and educational undertakings, he was willing to make comrades of the educational and scientific and technological departments serve as directors of the logistics departments. We hope that leaders at all levels will strive to serve as competent directors of the logistics departments in the course of carrying out reform undertakings. We will also strive to serve as good rear-service personnel for all of you.

To do a good job in logistics work, one of the most important tasks is to help the people eliminate misgivings and difficulties and to do a more practical work. In the course of eliminating misgivings and resolving difficulties, we should improve and show concern for the working conditions of intellectuals, reflect such efforts in our reform work, and solve the problems emerged in a timely manner. Here, I want to declare again that all departments and all trades and professions should support the reform of the scientific and technological structures. In my recent visits to some research institutes, I found that their scientific and technological measures were fairly backward, and their equipments were outdated which were unsuitable for carrying out scientific research ahead of other work. To solve such problems, we should give consideration to readjusting the orientation of investment during the Seventh 5-Year Plan period. The various municipal bureaus and enterprises should be determined to take a certain proportion of funds for scientific research from their industrial investment. Such funds should be applied to arm the scientific research units, including the scientific research departments of enterprises, in order to intensify their reserve strength.

Finally, I also want to stress this issue: In the course of reform, all communist party members should serve as pioneers and models. Leaders at all levels should firmly keep to the correct orientation of reform. The fundamental purpose of reform is to develop the productive forces. All our reform moves, methods, and measures should be conducive to realizing such goals and should not depart from such orientation. Reform is a new thing. Certainly, we will encounter risks and obstacles, and will have faults in our work. Therefore, we should sum up experience in making every move and should correct mistakes whenever discovered. So long as leaders at all levels keep a sober mind, all problems that have emerged in the course of reform will be resolved. At present, the second stage of party rectification is being carried out. Relevant units should closely link party rectification with reform and enable them to promote each other. It is impossible to smoothly carry out reform without the guarantee of party rectification. If party rectification deviates from reform, it will lose its practical significance.

All in all, I am convinced that, after this meeting, through the concerted efforts of all the people, we will surely create a new situation in Tianjin Municipality's scientific and technological work.

CSO: 4008/2030

NATIONAL DEVELOPMENTS

REFORMS IN RESEARCH SYSTEMS ON MILITARY TECHNOLOGY

Tianjin KEXUEXUE YU KEXUEJISHU GUANLI [SCIENTIOLOGY AND MANAGEMENT OF S&T] in Chinese No 5, 12 May 85 pp 11-12

[Article: "Comrades Bai Junde [4101 0193 1795] and Zhu Mingjin [2612 6900 6930] of the National Defense Science and Industry Commission System Reform Office Say: 'Scientific Research on Military Technology Also Should Undergo System Reforms--National Defense Scientific Research Organs Also Should Establish New Systems for Military and Civilian Unity and, Along With Guaranteeing the Completion of National Defense Tasks, Should Orient Toward Economic Construction, Accelerate the Transfer of Achievements in Military Technologies to Civilian Uses, and Make Great Efforts To Develop Developmental Research on Civilian Products"]

[Text] The national defense scientific research system is one of China's stronger S&T contingents. Since the 1960's, under coordination with related departments and units throughout China, we have successfully developed the atomic bomb, the hydrogen bomb, missiles, satellites and a group of conventional weapons and equipment.

They have made enormous contributions to the might of China's national defense and to raising the level of science and technology in our country. For historical and systemic reasons, however, scientific and technical achievements in national defense have not been transferred quickly to civilian uses and have not played a role in promoting the development of the national economy. Since the 3d plenum of the 11th CPC Central Committee, national defense S&T industries have adhered to the principle of uniting the military and civilians, and they have actively developed civilian uses. Gratifying progress has been made in the past few years. In 1984, for example, there was a rapid increase of 29 percent in value of output of civilian products in the nuclear, aviation, weapons and space departments. There were 8,000 items of military industrial technology transferred to civilian purposes, with an exchange totaling 400 million yuan. At a 1:10 ration, they could increase the value of output by about 4 billion yuan. Practice has proven that there is a great potential for national defense S&T industries to participate in national economic construction.

According to the "CPC Central Committee Decision Concerning Reforms in Scientific and Technical Systems" and in combination with real conditions in national defense S&T industries, we should begin by considering reforms in the following two areas in order to have national defense S&T industries participate even better in national economic construction.

1. Adhere to the principle of "guaranteeing the military and transfer for civilian purposes" and implement new systems to integrate the military and civilians. Based on the situation of scientific research and production tasks for national defense in the Seventh 5-Year Plan, there should be guidance by categories according to a classification of S&T units and factories. A preliminary classification is: Type 1, where military and civilian uses are integrated, while the military is the primary factor. Type 2, where military and civilian uses are integrated, while the people are the primary factor. Type 3, which is a total focus on civilian uses. On the basis of a classification of factories and institutes, there should be additional determination of duties and personnel for military product tasks. The goal of the reforms is to use a small and accurate S&T and production contingent to guarantee the completion of military product tasks and to strive as much as possible to have their forces participate in economic construction in order to serve the task of quadrupling the total value of industrial and agricultural output by the end of this century. As the same time, reforms in the management of military product production lines should be used to attain the goal of even greater productive capacity for serving economic construction.

2. Reform existing military industry S&T systems. Based on the two "Decisions" of the CPC Central Committee concerning reforms in economic systems and in S&T systems, the area of reforms in military industry S&T systems should be:

a. Management of military industry S&T should adhere to economic laws and the law of value. Although military products are special types of products, they also are commodities and the products of labor as well. They have qualities of value and price and must be accounted for in monetary terms. For this reasons, in an environment of development of the commodity economy on a national scale, management of military S&T also should adhere to economic laws of value. In addition, they should carry out compensated transfer according to the principle of the commercialization of technical achievements. The prices of military products also should embody the value created by S&T personnel in military industries. At the present time, however, prices for military products are established according to costs added to profits (stipulated at 5 percent of costs). This does not embody their real value and also leads to an irrational phenomenon of higher profits arising from higher costs. Reforms are essential.

b. In order to overcome the maladies of "eating out of the same big pot," the loans for military industry S&T also should be reformed. Based on the "Resolution," we implemented a technical contracting system for development and research units and gradually reduced administrative expenditures. A fund system was used for applied research and basic research tasks. Moreover, preparations are underway for a change in future expenditures on development (developmental research) of new weapons and equipment from the past method of dividing them among industrial departments to one of allocating expenditure indices for development to the departments that utilize the weapons and equipment and allowing them to sign development contracts directly with development departments. This will favor a meeting of demand and supply and will adhere to the principle of unifying responsibilities and rights. Based on the principle

of administrative simplification and downward transfer of authority, the National Defense Science and Industry Commission will focus on doing good work in macro policies and management and further motivate the initiative of all areas.

In summary, through our preliminary studies, we feel that the direction and principles of the reforms stipulated in "CPC Central Committee Decision Concerning Reforms in Scientific and Technical Systems" are fully suited to national defense S&T industries. After the issuance of the "Resolution," we must link up with the actual situation of national defense S&T according to the principle of the "Resolution" and formulate additional measures and programs for implementation of the "Resolution."

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NATIONAL DEVELOPMENTS

GOVERNOR ADDRESSES SCIENCE-TECHNOLOGY MEETING

OW281131 Hangzhou Zhejiang Provincial Service in Mandarin 1000 GMT 26 Aug 85

[Text] A provincial meeting on scientific and technological work ended in Moganshan today. The meeting noted: It is necessary to reform our science and technology structure step by step, implement the principle that economic development must rely on science and technology and that science and technology must be geared to economic construction, and avert separation of scientific and technological work from economic construction. Economic and scientific and technological workers should share weal and woe and devote themselves to invigorating Zhejiang's economy.

Attending today's meeting were responsible comrades of the Zhejiang Provincial CPC Committee, the provincial People's Congress, and the provincial People's Government, including Xue Ju, Wu Minda, Wang Qidong, Li Debao, and Xu Qichao. In the past 4 days more than 500 delegates have conscientiously studied the CPC Central Committee's decision on reform of the scientific and technological system and discussed revised policy of the provincial CPC Committee and the provincial government on implementing the central decision.

Governor Xue Ju delivered an important speech at today's meeting. He said: We must strive to complete reform of the scientific and technological system within 3 to 5 years. To achieve this goal, we must solve two important problems:

1. Gradually reform the method of operating the scientific and technological system and the method of allocating funds to scientific and technological institutions. We must replace state appropriations with the system of technical contracts, vigorously expand the technological market, and promote the commercialization of scientific and technological achievements. This will enable scientific and technological institutions to develop by relying on their own strength. Thus, they will have the vitality to consciously serve economic construction and social development.
2. Gradually reform the organization structure and encourage research institutes and institutions of higher learning to establish ties with production enterprises. By closely integrating scientific research, education, and production, we can turn scientific and technological achievements into productive forces. At the same time, we must vigorously assist enterprises in developing their own technologies.

Comrade Xue Ju pointed out: Our scientific and technological workers should strive to tackle research projects that have a bearing on economic growth as a whole and win a victory by using their intellectual power. At present, reform of the agricultural scientific and technological system should be aimed at serving the readjustment of the rural production structure and the development of the commodity economy in rural areas and at arming the medium-sized and small enterprises, including the village and town enterprises, with advanced technologies. At the same time, we must vigorously import advanced technologies from foreign countries, learn to apply them, develop our own new technologies according to our priority, and apply new technologies to transform products and enterprises.

He stressed: Party committees and government at all levels must strengthen their leadership over scientific, technological, and educational work. But this does not mean that they should actually take over professional work. It means that they should be good at discovering talents, uniting them, utilizing them, putting into full play the role of existing qualified personnel, and bringing up a large contingent of qualified personnel.

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NATIONAL DEVELOPMENTS

TRIAL IMPLEMENTATION OF S&T FUND SYSTEM

Tianjin KEXUEXUE YU KEXUEJISHU GUANLI [SCIENTIOLOGY AND MANAGEMENT OF S&T] in Chinese No 5, 12 May 85 pp 43-45

[Article by Hu Xian [5170 0494] of the Chinese Academy of Sciences Scientific Fund Committee Office: "Trial Implementation of Fund Systems Is an Important Reform of S&T Systems"]

[Text] Beginning in 1982, the Chinese Academy of Sciences Science Fund that was established through state allocations has been used primarily to provide financial aid for basic-type research work in the field of basic and applied research in the natural sciences. Practice over the past 3 years has proven that the decision of the Central Committee and State Council was a correct and farsighted one. The establishment of a scientific fund has played a definite role in alleviating the shortage in expenditures on basic research and on exploiting research potentials. Moreover, scientific fund management personnel have been trained and they have formed an evaluation contingent and system of professional colleagues on a substantial scale. They have accumulated experience for reforms in management systems of basic research.

I

From 1982 to 1984, the Fund Committee received 4,770 applications from scientific workers in 35 departments of the center and 28 provinces, autonomous regions and municipalities, and it has approved financial aid of 416.11 million yuan. After evaluating the results, a total of 2,696 research topics with financial aid totalling 120.33 million yuan were approved over a 3-year period. This was equivalent to 50.9 percent of the total number of applications and 29.9 percent of the amount of aid applied for.

The evaluation and approval work was done with substantial assistance by experts and scholars in many departments and units. A total of 24,780 professional evaluation letters were sent out over 3 years and 22,491 were received back, a recovery rate of 90.8 percent. About 5,000 experts participated in the evaluation and approval work for the scientific fund, and they gradually have formed a professional evaluation staff. More than 200 experts have taken responsibility for primary examination work.

Approval of topics for financial aid has adhered to the S&T policies of the party and focused on integration with the characteristics of basic research. It has focused on assistance to research topics that could have major effects on technology and the economy, on those that deal directly with China's natural resource conditions, and on those of great scientific significance. Under similar conditions, preferential assistance has been given to topics that were in applications submitted by middle-aged and young scientists and by scientific workers in frontier regions. Applied research accounted for 87 percent of the topics that received financial aid approval (mainly for basic work in applied research). More than 80 percent of the topics were submitted by scientific workers less than 55 years of age.

Approval of topics for financial aid embodied the principle of an orientation toward the nation as a whole. The topics receiving financial aid were distributed in 406 units in 34 central departments and, excluding Xizang, Ginghai and Taiwan, in 27 provinces, autonomous regions and municipalities. Institutions of higher education under direct jurisdiction of the Ministry of Education received 46.36 percent of the financial aid expenditures. Industrial, communications, agricultural, medical, national defense departments and units under local jurisdiction received 42.16 percent. Because we adopted some measures to limit the number of topics submitted from research institutes under the Chinese Academy of Sciences, they received only 10.26 percent of the financial aid fund. Large national cooperation projects received 1.75 percent. Institutes of higher education received the most at 79.4 percent.

The state has allocated a scientific fund of 90 million yuan over the past 3 years. We adopted a core financial aid total for topics receiving financial aid and used the method of issuing the funds according to the scheduled rate of research progress. Topical groups had been given a total of 54.23 million yuan by the end of 1984.

## II

After the establishment of the Chinese Academy of Sciences Science Fund, A Science Fund Committee composed of 23 study department committee members was set up. The Fund Committee formulated the "Trial Articles of Science Funds," "Trial Articles on Measures and Methods for Science Funds," "Key Assistance Principles" and other documents and a series of actual decisions and forms to serve as a common foundation for application, evaluation, approval and management. Our basic methods were:

### 1. Voluntary integration, direct application

Based on the party's S&T principles, the principle of using funds according to the conditions of selecting the best and key assistance or the "Guide to Topic Selection," S&T personnel started from their own advantages and on the basis of their original research work. They were integrated freely with leadership and filled in scientific fund applications according to the stipulated requirements. After examination and evaluation by their own unit, the applications may be sent at any time to the Fund Commission. Topics submitted before March of each year can be fully approved by the fourth quarter of the same year.

## 2. Professional evaluation, select the best for assistance

The applications received by the Fund Commission were sifted through in a preliminary fashion by work personnel. All applications that had a research scope, application content and application procedures that conformed to the requirements were sent out to professional experts with more than 5 years of experience in S&T development trends and substantial scholarly attainments who would handle them impartially for communication and evaluation. Management personnel dealt directly with the needed investigations. Finally, special primary examination experts synthesized the professional opinions. They offered their views on financial aid based on the principle of selecting the best, offered their opinions concerning financial aid and submitted them to the scientific fund group according to their subject area for approval. There was a focus on assistance to research topics that were of great scientific significance and applied value, where the quality of the applicant and his cooperators was good, where research programs were advanced, feasible, clear and concrete and for which there was basic work. The fund group offered opinions on its investigations for single projects exceeding 100,000 yuan and presented them to the Fund Committee for approval.

## 3. Fund allocation according to topic, special funds for special uses

After projects receiving financial aid were approved and sent down, a topical group proposed a research work plan and filled in the grant application according to stages. After approval by the Fund Committee office, the expenditures were allocated to the applicant's units. Accounts were established for each project and the topical groups has responsibility for the use of the funds. A topic expenditure income-outlay table is submitted to the Fund Committee each year.

## 4. Responsibility by the applicant, supervision and guarantee by the unit

The applicants are responsible for all aspects of a topic receiving financial aid from the scientific fund from the time of application and receiving the financial aid to the formation and implementation of research plans. They have independent decision-making rights in the selections of topical group personnel, in formulation and readjustment of research programs, in direction of the research work, in allocation of the financial aid expenditures and in other areas. Their units will provide guidance and coordination in topic selection and research programs in order to improve the competitive ability of the topic being applied for. After obtaining approval, [the units] provide them with guaranteed working conditions and also practice examination and supervision of the research work and expenditures.

## 5. Investigation at set intervals, timely guidance

In order to understand fully the work situation for topics receiving financial aid in a timely manner, we decided that the topical groups should submit a report on research progress and an annual work plan for the coming year to the Fund Committee on an annual basis. The units in which they work also should carry out investigations at fixed periods and write a comprehensive

report on the work situation in topics receiving financial aid in their own unit. Personnel in the Fund Committee Office and the fund groups in each field also should take the time to gain an understanding by making investigations in some units. They should listen to opinions, solve problems and, based on the "Science Fund Work Report," they should praise the advanced and criticize the backward to promote research and management work for topics receiving financial aid. For those topics that have been determined to be truly incapable of proceeding with their research work, grants and the scattering of financial aid should be discontinued. After all the research work for a topic receiving financial aid is completed, there should be a conscientious summarization and preparation of a written report in combination with an academic treatise, data on evaluation and appraisal of the results and a full accounting of outlays and expenditures to be turned over to the related leaders of the unit. After examination and appraisal by the leadership of the unit, the report is sent to the Science Fund Committee.

### III

Progress in research work on topics receiving financial aid from the Science Fund has been excellent. According to reports concerning the 1,084 research topics approved for financial aid in 1982 and 1983, some 1,062 or 98 percent of them have completed or basically completed their predicted research work plans. Entire original research work plans have been completed on 109 topics. Because of factors such as a failure to obtain instruments and equipment, the fact that the applicant may have gone abroad or changed their position, ineffective assistance and guarantees from the units involved and other things, only 22 topics receiving financial aid or 2 percent of the total have not completed their research work as predicted.

According to incomplete statistics, 2,821 academic treatises were completed by topics receiving financial aid over the same 2-year period. Some 854 of them were published in influential Chinese or foreign journals or presented at international academic conferences. Some 60 research achievements or stages of achievements have been given technical appraisals or expert evaluations. State, departmental or local awards have been given to 10 achievements. Research levels in some topics stand at the front ranks worldwide. Some achievements of applied value now are being tested on an expanded scale in production or being extended. Examples include:

After the topic "A Discussion of Basic Questions in Astrogeology" submitted by Xu Daoyi [1776 6670 0001], a middle-aged scientist in the State Seismology Bureau Geology Institute and others received financial aid, they cooperated with scientific workers in geology, stratigraphy, paleontology, structure, geochemistry, nuclear chemistry, nuclear physics and other disciplines and undertook research on with "the relationship between important geological boundary lines and rare cosmic events." After 2 years of diligent laboratory and field work, they discovered iridium content anomalies in the stratigraphic profiles of three different geological eras in China. They wrote three articles concerning the effects of asteroid collisions with the earth on the development and progress of geological history that were presented at Chinese and foreign geological conferences. They attracted deep interest from

colleagues from more than 10 nations. The U.S. "Science News" published a special report and the Royal Family Society heard an introduction to this research achievement. The International Geology Society established a special Chinese work group that will convene the first academic conference on "rare geologic events" in China in 1986. In a recently-convened meeting to evaluate research on this topic, experts gave a high evaluation of their work.

After an article on "indistinct topology" from a research project directed by Professors Pu Baoming [5543 0202 2494] and Liu Yingming [0491 2019 2494] at Sichuan University was published in ZHONGGUO KEXUE [Science in China] and in related international academic journals, it was confirmed fully by Professor (Chade), the founder of fuzzy mathematics, and it received good evaluations from colleagues in France, Japan, Poland, Belgium, West Germany and other nations. It was described by the Fuzzy [Mathematics] Information Processing Society as "relatively important, an important step forward." It is to be included in the book "Fuzzy [Mathematics] Information Analysis" to be published in the U.S. and in related academic journals in France.

Furthermore, the topic on "the theory of biliary tract rheology and applied research" directed by Associate Professor Wu Yunpeng [0702 0061 7720] at Chongqing University, the topic concerning "research on laws of metamorphism and energy parameters of plate and belt material during asynchronous rolling manufacture" directed by Professor Zhu Quan [2612 3123] at the Northeast College of Industry, the topic concerning "regulation of hypothalmic--weight--ovarian axis activity by tyrosine" directed by Professor Cheng Zhiping [4453 3112 1627] of Harbin Medical University, the topic concerning "research on the component structure and properties of powdered coal ash, slag and silicate glass state gel material" directed by Professor Yuan Runzhang [5913 3387 4545] of the Wuhan Construction Materials Industry College, the topic concerning "research on the composition and properties of a new type of molecular sieve" directed by Professor Li Hexuan [2621 6378 0753] at Nankai University, and research on a new method for removing carbon dioxide from raw material gas and on desulfurization of waste gas directed by Professor Shi Yajun [2457 0068 6874] at the East China Chemical Industry College all have achieved major results and have attracted a high degree of attention at home and abroad. Some already have become forces of production and are providing visible economic results.

#### IV

Although the Science Fund has been in trial operation for only a short time and changes in grant allocation methods still are limited to state allocations to the Fund Committee, its superiority is quite obvious.

1. It has aided in overcoming such maladies as departmental separation and eating out of the big common pot, and it has promoted competition and integration.

The Science Fund discarded the method of expenditure distribution based on a multilayer division by departments, regions and units. It has been replaced by a method of selection of the best for assistance through project grants.

This has encouraged applicants to compete according to their scholarly level, creative abilities and work achievements. This has improved the level and efficiency of scientific research and avoided repetition at low levels, and it has caused the most capable people to show off their talents. The membership of topical groups can cut across unit, departmental and regional boundaries and the outlays are not restricted by "departmental separations." This has benefitted the exchange and interflow of scholarly ideas, the growth of the marginal sciences, the rational circulation of personnel and the achievement of large cooperative tasks.

2. It has aided in strengthening responsibility systems in scientific research and in motivating the enthusiasm, initiative and creativity of scientific research personnel.

Allowing people to take the initiative to apply, evaluation by colleagues, applicant responsibility, supervision and guarantee by the units and other methods implemented by the Scientific Committee has promoted the leading role of scientific research personnel in scientific research work has been rather well. This has strengthened their feelings of glory, their sense of responsibility and their spirit of unity and cooperation. It has expanded the decision-making rights of the topical groups and made full use of the enthusiasm, initiative and creativity of scientific research personnel. Many scientific researchers and scientific research units have received financial aid from the Science Fund. They treat it not only as material assistance but as academic prestige, and they consider whether or not they are able to obtain results as scheduled to be related to the maintenance of their reputations. They feel an inner force and external pressure. They pay attention to improving the competitive ability of topic applications and concentrate on arrangements, implementation, examination, management and other work after receiving approval. Some units have organized preliminary evaluations by colleagues before submitting their applications. There is mobilization after approval is obtained and they emphasize "maintaining reputations, getting results."

3. It has benefitted the development of basic research work.

Sources of expenditures for basic research are rather hard to come by. This is especially true with the increased shortage of basic research expenditures in institutions of higher education. Moreover, the sources are unstable. This has affected utilization of latent research strengths and caused a situation where many significant topics cannot be done and where things to be discarded cannot be endured. The establishment of the Science Fund has provided assistance to research topics based on new ideas, of great significance or where basic work has been done. A group of talented scientific research personnel are engaged wholeheartedly in going further with their basic research work. This has caused many scientific research personnel who have obtained financial aid to see the Science Fund as a "timely rain" and as "coal during the winter," and they hope that the scale of the scientific research fund system can be expanded.

4. It has aided in adherence to the party's policies concerning science and technology, and has implemented state S&T development planning.

Through the announcement of the principles of financial aid along with some guides to topic selection and evaluation and selection by expert colleagues under conditions of choice of the best topics, the Science Fund can orient research topics to the needs of national construction of the four modernizations and make full use of the limited expenditures possible, and it can eliminate unneeded scattering and repetition. The reason is that topics selected for application to the Science Fund need not be restricted to the guidebooks. Ideas and suggestions not included in the plans and guidebooks do not lose the opportunity to receive assistance. This has integrated guidance from the upper to lower levels with applications from the lower to upper levels and it has caused basic research to better serve the overall goals of the four modernizations drive.

5. It encourages full use of expert advice and guidance, and it improves the party's leadership of research work.

The Science Fund receives applications directly from basic level S&T workers and relies on expert colleagues to evaluate them. The evaluation and approval organs are organized of specialists from each department and each discipline. Evaluation and approval work makes full use of democracy and the advisory and guiding role of experts in academic areas. The result has been that party leadership of research work has become more suited to the characteristics and regularities of basic research. The universal response to the evaluation and approval work in S&T circles has been that it is rigorous, fair and fundamentally correct. No leader at any level in the Chinese Academy of Sciences has used administrative measures to interfere in any degree.

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NATIONAL DEVELOPMENTS

DISCUSSION OF REFORMS IN CHINESE ACADEMY OF SCIENCES

Beijing KEYAN GUANLI [SCIENTIFIC RESEARCH MANAGEMENT] in Chinese No 2, Apr 85  
pp 1-4, 16

[Article by Wang Minxi [3076 2404 3556] of the Chinese Academy of Sciences Management Science Group: "The Prospects for Reforms in the Chinese Academy of Sciences"]

[Text] The CPC Central Committee proposed a blueprint for comprehensive reforms in economic systems in its "Decisions Concerning Reforms in Economic Systems" that inevitably will greatly accelerate reforms nationwide. The basic task of reforms in economic systems is to promote development of the social forces of production. The decision pointed that "during the process of carrying out reforms, all comrades in the party should concentrate closely on this basic tenet of Marxism and make whether or not they benefit development of the social forces of production the primary standard for examining the success or failure of all reforms." Development of the social forces of production is a strategic requirement for achieving the magnificent goal of quadrupling the total value of industrial and agricultural production by the end of this century.

Science is a force of production, but it exists in the form of knowledge that must be transformed under certain conditions before it can become a direct force of production in society. Economic systems are an important condition for its conversion and reforms in economic systems serve to better enable the economy to absorb the newest modern scientific and technical achievements and thereby promote scientific and technical progress and create even higher forces of production for society.

Under these conditions, the patterns and tasks that the Chinese Academy of Sciences [CAS] faces, whether or not the current situation can adapt to objective forms, which main problems to concentrate on in order to be able to implement effectively the official statement "Outline Report on the Question of Reforms" given to the Chinese Academy of Sciences by the CPC Central Committee and the State Council have become important questions of common concern within and outside of the Academy. The goal of this article is joint discussion with those who are concerned.

I. New Situations, New Tasks

Since the founding of New China, the attention and concern of the party and the superiority of the socialist system have brought about major developments in science and technology in China. There were only 21 natural science and social science research institutes in China before liberation, and a research staff of over 200. Now, the CAS alone has 119 research units and a scientific and technical research staff of more than 30,000. The CAS has played an important role in formulating and implementing national long-term scientific and technical development plans. Because of the extremely difficult situation during the early 1960's, scientific and technical personnel in China had independent decision-making rights and relied on their own efforts in striving to cooperate for successful completion of trial designs for the "two bombs and one star" [atomic and hydrogen bombs, satellites] within a relatively short time. The CAS deployed about 40 percent of its scientific and technical forces during these tasks and made important contributions to national defense construction. Work in the CAS was seriously damaged during the 10 years of chaos in the Great Cultural Revolution. There has been a strategic shift in the focus of party work since the 3d Plenum of the 11th CPC Central Committee. Leading comrades in the CPC Central Committee and the State Council have given instructions on the orientation and tasks of work in the CAS. Premier Zhao Ziyang put forth the important principle that "economic construction should rely on science and technology, while science and technology should be oriented toward economic construction" in 1982. In 1983, the CPC Central Committee pointed out that the CAS should "strive to strengthen the applied sciences, actively and selectively participate in development work and continue to pay attention to the basic sciences." In November 1984, the CPC Central Committee and the State Council gave their formal response to the CAS "Outlined Report on the Question of Reforms." It called on the CAS to organize actively trial implementation and use continual summarization of experiences to perfect it. Moreover, there was hope that all related regions and departments would assist the CAS in the reform work.

The CPC Central Committee has given a clear goal of struggle to the party and to the people of China, and it has given a blueprint for comprehensive reforms in economic systems. The smooth development party consolidation work has strengthened party construction and leadership. All of this is an excellent situation faced by the CAS and all other such units across China. At the same time, the CPC Central Committee and the State Council responded to the CAS "Outlines Report on the Question of Reforms" and gave clear instructions to the CAS concerning the guiding ideology of the CAS, the focus at present, the direction of long-term developments, and questions related to aiding reforms in the CAS. This has created the conditions and opened a path for the CAS leadership to give a free reign to mobilization of the wisdom and efforts of all personnel in the CAS for active and stable reforms. The above is a favorable situation faced by the CAS.

It should be noted, however, that the new situation has brought on new tasks under new historical conditions and that the current situation in the CAS cannot adapt completely to the demands of the new tasks. This makes full evaluation of the difficulty of the reform process and arrangement of the corresponding measures essential for gradual achievement of the CPC Central Committee's decisions. Overall, there are several primary aspects of the situation:

1. The CPC Central Committee's opening up to the outside and invigoration of domestic economic policies have brought the CAS into the competitive currents of international and domestic technology markets. We participated in attacks on key problems in the national defense industry and gained valuable experience during the 1960's, but there were special conditions at that time. The first was that there was a situation in which science and technology had been closed off, and where there was national cooperation to attack key problems, centralized leadership, clear tasks and no competition to import technology. The second was that the state provided key guarantees in the areas of personal, financing and materials. The current situation is that special economic zones and 14 coastal cities within China have been opened up to the outside. The CPC Central Committee's direction is to strengthen the vitality of enterprises in these regions and the focus is on technical transformation of old enterprises. The starting point should be high, however. To deal with these enterprises in its applied science and development work, the CAS first must select correct topics. Projects with an original weak foundation and where there is a possibility of importing [technology] cannot be included in scientific research plans. Secondly, there should be a focus on the economic results produced by scientific research achievements after they are put into production and on whether or not the products are able to compete in international markets. Third, there must be close coordination with the connected producing enterprises to achieve a substantial reduction in the amount of time between development work and formal production, because the economic benefits cannot be separated from speed. Basic research is the foundation of applied research and development work. The latter requires an ability to compete in international technology markets, meaning that basic research and some of the applied research in the CAS should be oriented toward the world and toward the future. For this reason, the CAS not only should focus on trends in all disciplines and areas, but also should obtain timely international technical and economic information. Not only should there be great efforts to train talented scientific personnel and improve the levels of research work, but personnel in the areas of engineering technology, management and administration also should be trained. There should be rational staff structures and matched personnel. Only in this way will it be possible to have a competitive ability to complete the new tasks under the new situation.

2. To achieve the magnificent goal of quadrupling the total value of industrial and agricultural output, the CAS not only should engage in construction of scientific and technical modernization, but also should make contributions to construction in industry, agriculture and national defense. There must be work to improve and develop the depth and breadth of research work in the CAS. On the one hand, the CAS must assume direct responsibility for state projects involving attacks on major key problems or focal projects, while on the other hand it must offer plans and policies for major scientific and technical problems in national construction. The CAS must become good at solving problems as well as proposing questions, and it must solve current problems while dealing with long-term development strategies.

3. The great variety of economic construction tasks and limited state finances require us to cherish the state's investments in scientific research. We should use the least amount of investments to obtain the maximum socioeconomic

results. For this reason, not only must the CAS study and grasp the laws of scientific and technical development, but it also must study and grasp the objective laws of economic development so that the two are integrated and dialectically united and so that they are mutually promotive.

4. There are four routes for development of the social forces of production. The first is technical transformation in original enterprises. The second is to develop new industries by focusing on new technologies. The third is to improve management and administration levels in enterprises so that everyone can make use of their talents and all materials are used properly. The reason is that advanced managerial skills can become the most important factor in promoting economic development. The fourth is to improve the educational levels and the scientific and technical levels of enterprise employees so they can understand advanced science and technology. The CAS has a large middle-aged scientific and technical backbone [staff] with a fairly high level of scientific training and technical [skills]. They can play a major role in the first two routes and actively make major contributions. The CAS Systems Science Research Institute, the Applied Mathematics Research Institute and the Psychological Research Institute have established research offices or research groups for research on the managerial sciences. They have done a large amount of work in discussing major state engineering projects and in improving management and administration levels and the quality of leading cadres in enterprises. The CAS should pay attention to and assist in the popularization of research achievements in this area, and it should strengthen construction of disciplines and staffs. In this way, it will make even greater contributions in the third channel to development of the social forces of production. Moreover, it also should pay a great deal of attention to integration with the transfer of rights over scientific research achievements, to personnel training in industrial departments or to the absorption of engineering, technical, managerial and administrative personnel from industrial departments for participation in the related research work of the CAS.

## II. The Guiding Ideology and Central Links of Reforms

In adherence with the spirit of the CPC Central Committee Secretariat and the State Council, the guiding ideology of the CAS is to make great efforts to encourage and assist research institutes and scientific and technical personnel to go into socialist modernization and construction, to gain more and faster results, and to provide more talented people in a faster manner.

The CPC Central Committee's "Decisions Concerning Reforms in Economic Systems" state clearly that greater enterprise vitality is the central link of reforms in economic systems. Enterprises truly must become economic entities with substantial independence and they must become producers and managers of socialist commodities who handle their own administrative decisions and who are responsible for their own profits and losses. The enterprises must come to have the ability of self-transformation and self-development and become corporations with specific rights and duties. If the enterprises can be given greater vitality, it will greatly increase their ability to absorb science and technology. This will require stronger close coordination and cooperation among research institutes and among scientific and technical personnel. In adherence

with the spirit of the CPC Central Committee "Resolutions Concerning Reforms in Economic Systems," the CAS should simplify administration and relax policies. It should expand the decision-making rights of research institutes and turn them loose to give them greater vitality. This is the central link of reforms in the CAS. Invigoration of research is essential for motivating the initiative of all personnel in the institutes, especially the vast ranks of scientific and technical personnel. Only in this way will a broad strengthening of horizontal linkages be possible and will everyone be capable of distinguishing themselves and playing their proper role. The CAS should practice management by categories according to the different qualities of research work, and it must place different demands on different regions and different levels. Generally speaking, it can be divided into two levels. The first level is the research institutes in the Beijing area and in the 14 coastal cities opened to the outside. Demands in two areas should be placed on them. The first is to have an international orientation. Whether speaking of basic research, applied research and developmental work or of management and administration levels, all should be able to compete on an international level. Only in this way will it truly be possible for them to make the appropriate contributions to economic construction in the open cities. The second area is to support and assist research institutes in frontier regions and in the interior. The second level is the research institutes in frontier regions and in the interior. Their scientific and technical levles are advantageous in these regions. They should make full use of the natural resource advantages of their regions to make contributions to economic construction in their regions and to form research work characteristics of their areas so that they gradually enter the ranks of those able to compete at international levels. In the long run, the CAS should centralize its forces to operate a group of key research institutes that have a high level and that can solve major problems in economic construction and scientific and technical development for the state. In terms of the current reforms, however, the focus of work at all levels of leadership should be to enliven the research institutes, to give them greater decision-making rights and to improve the levels of scientific research and management and administration so that they make more contributions to socialist construction. Determination of key research institutes in the future should consider the benefits for national economic construction and should consider the high-level development of science and technology.

The success or failure of reforms in the departments and organs of the CAS will have major effects on reforms through the academy. They should be carried out in a positive yet careful manner. We certainly cannot accomplish the whole task in one stroke. A downward transfer of authority should be the prerequisite of administrative simplification. The establishment of a brain trust should be the prerequisite of macro policies. Improved work efficiency should depend on administrative simplification, and greater attention should be given to feed-back system information analysis and management. After the preliminary formulation of primary organizational tasks, the primary goal should be to enliven the research institutes. Begin with the need to enliven the research institutes and further intensify organizational reforms. The key to success or failure in the research institute reforms is the quality and structure of institute leadership organs. The nucleus of the successful reforms in academy organs lies in whether or not the quality and structure of leading cadres meet requirements.

### III. Reform Plan Administration, Formulate Good Long-Term Plans and Rolling Plans

Invigoration of research institutes requires reforms in scientific research plan management. Looking at the overall situation in the CAS, directive scientific research plans account for only about 20 percent of the total, so each research institute has a great deal of decision-making authority in the selection of scientific research plan topics. The main problems in plan management in the CAS are: First, a lack of strong leadership and effective organization and coordination in directive scientific research plan projects, with a lack of unity in job responsibility and slowness in examination, supervision and problem solving. Second, there is no guide for topic selection in guidance scientific research plan projects. Instead, there mainly is a situation in which each institute selects its own topics. The result is scattering and repetition as well as waste of manpower and materials in projects in this area. Third, those projects urgently needed in economic construction and with definite "markets," and for which many research institutes could provide achievements or advisory services, have not received attention for a long time and have not been encouraged. During the reforms, most research institutes developed work in this area and many institutes have established development companies. This has shortened the time period of scientific research production. Based on market demand and timely provision of scientific research achievements, scientific equipment has been converted into direct forces of production in society. At the same time, the scientific and technical potential of the research institutes has been exploited to open up technology markets, create wealth for society and increase the incomes of units and individuals. This has motivated the initiative of even more scientific and technical personnel.

Whether we are speaking of the adoption of contract systems to increase leadership and organizational coordination of directive scientific research plan projects or formulating a guide to topic selection to strengthen guidance of directive scientific research plan projects, everything requires a basis of a long-term plan that is suited to China's actual conditions and has a strategic developmental ideology. Although the CAS has formulated a preliminary long-term draft plan, the need for good reforms in the CAS and for implementation of the "response" of the CPC Central Committee requires that we listen to the opinions of all related departments and that we conscientiously organize all of the academy's personnel, especially scientific and technical personnel and administrative personnel, for intensive discussions and formulation of a long-term plan and for the reformulation of a good 5-year "rolling plan" on this basis. Only in this way is it possible for the management method that uses a fund system and contract system to be fully utilized. At the same time, we must consider the fact that research work is creative labor and that it is different from production of a product. Greater freedom certainly must be given to the research institutes. Furthermore, an important factor for improvement of management levels throughout the academy is conscientious study and scientific formulation of the proportion of directive projects, guidance projects and market regulation projects.

#### IV. Close Attention Should Be Given to Training Young Scientific and Technical Personnel and Managerial and Administrative Personnel

The Academic Departments Committee of the CAS represents the excellent scientific and technical staffs all over China. Each research institute under the CAS also has a large group of academic leaders with a high level. When looking at the current situation, however, the age and outdated knowledge of upper and middle level personnel among scientific and technical staffs still is quite common. The 10 years of chaos during the Great Cultural Revolution resulted in a failure to form a rational echelon in the age structure. In another area, the situation of arranging seniority according to years of service means that talented young scientific and technical personnel have few opportunities to be selected and take on heavy responsibilities. The CAS must pay attention to the construction of spiritual civilization and foster a spirit of dedication to the cause of science. Moreover, we should create a good research environment and working conditions and strengthen training of talented young scientific and technical personnel so that they will mature more quickly. A regular contract system should be formed for sending research personnel from the CAS to teach in colleges and specialized schools and to allow professors from colleges and specialized schools to use CAS laboratories to develop research work. This will aid in the early discovery of talented young scientific and technical personnel and in training them even better. The CAS established a scientific research fund for young scientific and technical personnel and a widespread post-doctoral training system very early in the reforms. These measures will have a profound influence on the training of young scientific and technical personnel.

Part Nine of the CPC Central Committee "resolutions Concerning Reforms in Economic Systems" points out that "reforms in economic systems and development of the national economy urgently require large number of managerial and administrative personnel who have modern economic and technical knowledge, who have a spirit of innovation, who dare to be creative and who can open up a new situation." The CAS serves as a scientific research organization. It should make more and faster achievements, which means relying on scientific research personnel as well as managerial and administrative personnel. The reason is that the latter creates excellent research conditions for the former and also converts research achievements even more quickly into direct social forces of production.

The "Outline Report Concerning Questions of Reforms" given to the CPC Central Committee by the CAS points out that the academy should use reforms to become truly a national comprehensive natural science research center. We need this center for several reasons. The first is that we should use investigation, examination and analysis of the domestic situation for active proposals of scientific and technical questions that have profound influences as major and key aspects of economic construction. The second is that we must be good at dividing up these major questions into research topics. The third is that we should organize large-scale cooperation of different disciplines, which means that the natural sciences should cooperate with the other sciences as well as with the social sciences. Fourth, there should be scientific management based on the principles of modern managerial science. A national comprehensive research center for the natural sciences should make full use of

academic democracy and enliven academic thought. It should encourage mutual permeation of different disciplines and create an excellent environment and conditions for the sprouts of vanguard disciplines. A national comprehensive research center for the natural sciences not only requires its own excellent academic leaders and managerial and administrative personnel, but also must train excellent scientific and construction personnel for the country. Obtaining more and faster achievements is the motive force and result of training more talented people in a faster manner. The building of such a strong scientific and technical staff will not be easy. If the CAS is unable to advance during the reforms, however, and is unable to achieve the above goals in the end, how will we be able to complete the historical tasks given to us by the party and the people?

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CSO: 4008/2017

NATIONAL DEVELOPMENTS

CULTIVATING LARGE NUMBER OF YOUNG SCIENTISTS URGED

Shanghai WENHUI BAO in Chinese 19 Jan 85 p 1

[Article by Yan Dongsheng [0917 2639 3932], secretary of party unit and Vice President of the Chinese Academy of Sciences [CAS]: "Cultivate Large Numbers of Young Scientists"]

[Text] The talent problem is an important strategic problem and also an important problem concerning the survival and death of the CAS. Now the most eminent task in front of us is to cultivate large numbers of young scientists. Only after accomplishing this task, can the future scientific development become prosperous and advanced, have continuous explosive and staying power, and have the ability to solve the important problems confronting us today.

Young scientific and technological talented personnel have a strong desire for acquiring knowledge, have sensitive responses to the world new technological revolution and have the ambitions to catch up to the front-runners in the competitions. Some of them are outstanding among their peers and have creative inspiration, profound knowledge and achievements, and they ought to be called young scientists. We must be adept to discover them, brave to recognize them and dare to give them important responsibilities. We should not nitpick with them, ridicule them and refuse them opportunities.

In the field of natural sciences, young people are most creative in their 30s. Chinese scientists of the old generation, such as Li Siguang, Zhu Kezheng, Zhou Peiyuan, Qian Xuesen, Yan Jici, Hua Logeng, Mao Yisheng, Li Guohao and so forth achieved their outstanding accomplishments and became reknown at a young age. Many famous senior scientists at CAS were still very young in the founding years of the republic, but they already had accomplishments and became well-known. In reminiscences of my younger years, I was appointed as researcher and deputy director of Shanghai Silicate Research Institute at the age of 31 under the care and support of the senior scientists. In the mid-50s and late 50s several young college graduates in their 20s came to the Silicate Institute. Because of their outstanding achievements in some particular areas, the institute appointed them as research project chiefs and assigned them with research assistants and deliberately gave them support and encouragement to groom them into scientific research leading workers. The present director and deputy director of the silicate institute, Guo Jingkun [6753 2529 2492] and Wang Yongling [3769 3057 7881] were among the most praiseworthy young scientists then. Now in many research institutes of CAS there are

large numbers of young scientists who have great potential, ambition and futures. They are there waiting for us to discover them.

In addition to good political qualifications, young scientists in general all have the dedication for scientific study and insatiable desire for new knowledge and are in pursuit of new discoveries and new inventions. Even if there are some weaknesses in their performances, these are natural phenomena in their development and growth. There are many types of talented personnel among the young scientists: some are inventive and creative. They can sense and detect the clues and hints in the most obscure areas and can discover some of the mysteries in the nature. They are able to propose and explain new theorems and laws which were unknown in the past. Some are technologically inventive; they are imaginative and skillful with their hands. They are skilled at putting scientific principles into practice or combining several disciplines together to create a new product or a group of new products, and in turn, transform them into economic gains. Still some others are skillful in scientific management and experts in the soft sciences. They have certain profound scientific knowledge (also called scientific background) and can consider macro-theories, mid-range theories and micro-theories all together and set out policies which are practical and efficient. They are good at grouping things together for better sense and efficiency. All these types of scientists are rare and valuable. We must be competent at discovering them and make efforts to cultivate them.

Due to the factors of the scientific research structure and the obstacles of habitual practices, many outstanding young scientists and talents are not given the opportunities to become recognized. Our history handed down to us a good tradition of respecting the old and senior, while at the same it burdened us with the inhibition to pay attention to the young. In front of the old scientists, middle-aged scientific and technological workers cannot obtain prominent positions and their opinions do not carry enough weight; likewise, in the eyes of middle-aged scientific workers, young scientific and technological workers' opinions will not be given enough attention either. This habit has hindered the ability of middle-aged and young scientific workers to express fully their opinions and reveal their talents. This situation must be corrected immediately. We must create the following atmosphere: that in all areas of study, all are equal regardless of position or age. The only criterion is seeking the scholastic truth. We must create the environment for the young scientists to grow and develop completely. We will give praise and publicity to the deeds of old scientists giving guidance, support and important works to the young scientists. Only by making "students better than their teachers" can we have a flourishing scientific enterprise.

CAS is determined to continue selecting the middle-aged and young scientists who are capable in human affairs and have the ability in organization and administration to take leading positions at all levels; to place them in positions as members of department of the scientific council, members of academic commissions, and members of editor boards of scientific publications; and to make them the backbones of the scientific organizations. Now the average age of the department members of the scientific council is over 70 and we need young blood. We allow outstanding young scientists to enter the

high-level academic positions, and this is the demand of the times. As far as the middle-aged and young scientific and technological workers who are qualified for high-level research are concerned, we firmly and boldly will promote them to the positions of higher research regardless of their seniority or years of service. In order to cultivate the young scientists and technological workers (including the middle-aged) going overseas to attend international scholastic conferences, joint research programs, lecture engagements, higher studies etc., as long as they receive financial assistance from overseas they are allowed to go overseas. In consideration of the demand of development in the 90s and even further in the future, we are aiming at the cultivation of even younger scientific and technological talents and for this reason we are to increase the enrollment of graduate students, to set up a pilot 'post doctorate' research system for trial, and to establish a number of 'post-doctorate' mobile work centers. We are to set up funds for young scientific and technological workers immediately to give financial assistance and awards to young creative talented personnel under 35-year old.

I hope that our young scientists rise quickly.

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NATIONAL DEVELOPMENTS

INITIAL SUCCESS OF REFORM OF ANHUI SAT STRUCTURE

Hefei ANHUI RIBAO in Chinese 8 Feb 85 p 3

[Article by Xia Qinnong [1115 0530 u593]: "The Reform of the Scientific and Technological Structure of our Province Has Shown Initial Success"]

[Text] Work on the reform of Anhui's scientific and technological system started fairly early, extended from the specific to the general and gradually began to take shape. It began with an experiment at the provincial chemical engineering institute and other four units, and the development has been rapid. Up to date, there are more than 80 scientific research units which have drawn up reform plans and 38 technological development units which have adopted the contract with remuneration system. They represent 52 percent of the total number of the same type of research units in the province. The eight cities under the provincial government administration all adopted the contract with remuneration system in research and development programs since 1984. As a whole, the approach of the reform of the scientific and technological structure is correct, its development is healthy and has shown preliminary successful results.

Prior to the reform, the works of the scientific research units were assigned to them by their superior agencies and their operational funds were appropriated to them by their superior agencies. They lacked the pressures, the dynamics and the energy to combine their research efforts with the growth of the economy and the development of production. The reform has immensely heightened the initiative and creativity of the scientific research units which, under the premises of guaranteeing the completion of the tasks assigned to them by the state and their superiors, turn themselves towards the society and production and extensively accept research projects from all enterprises. They aggressively promote the research results, transfer technologies and engage in technological services. Recently, we did a survey of 26 scientific research units. They signed 408 remunerative technology-transfer contracts with 159 factory and mining enterprises and received 4.5 million yuan, an increase of 2.19 million yuan over 1983. With these funds, they can do research works on more subjects and create more research results and they also can improve their scientific research conditions. A survey of nine research units, including the provincial building materials institute, reveals that after the adoption of the remunerative contract system they received more than 3.49 million yuan which is 81 percent of their operational expenditures. In the past, the provincial chemical

engineering institute had an average of 8.5 research projects per year, in 1983 it had 32 projects and last year it had 82; and it had a successful research rate 59 percent and a rate of promoting results of 80 percent. Bengbu City's eight scientific research units completed 31 scientific and technological research projects from January through September of 1984 which equals the total of the previous three years, and an income of 455,000 yuan which also equals the total of the previous three years.

In the past, the scientific units were in a closed-door environment that hindered the promotion and application of scientific and technological research results. The reform has broken loose departmental and regional bondages and pushed the scientific and technological endeavor towards the needs of the society. The Applied Technology Research Institute of Suxian Prefecture is a small 22-person unit, however in 1983, 168 units from 23 different provinces, municipalities and autonomous regions requested it to provide technology transfer and technological services. It created a new production value of more than 40 million yuan, solved the unemployment of over 2,000 people and rescued several small factories. With massive efforts to open up the technology market and to accelerate the commercialization of the scientific and technological research results, the province has first set up 14 technology development centers, 35 technology service consultation companies and 33 technology exchange centers, and there are more than 70 scientific research and production combined development projects. This type of organization helps better coordinate the strengths of various units to develop new technologies and new products and helps promote the application of scientific and technological results. Placing technologies directly in the marketplace for exchange and transfer has accelerated the application of technologies into production and enhanced economic construction. The province has sponsored 45 large-scale technology exchange fairs and facilitated 839 technology transfers. Of them, 386 items have produced an economic value of 15.7 million yuan and the application of 450 items of technology results has yielded an annual economic yield of 130 million yuan.

In the process of the reform, many scientific research units throughout insisted on keeping scientific research as their major task and correctly balanced the relations between short-term benefits and long-term benefits and placed a high priority on technological reserves. According to statistical sampling, of the province's scientific and technological research projects in 1984, 18 percent were applied tasks on a technological basis and 82 percent were development tasks: this proportion is appropriate. In the group of active revenue-raising units, they primarily rely on technological revenues. For example, the high-revenue provincial chemical engineering institutes received more than 800,000 yuan in 1984, of which two-thirds was technological income.

In order to solve the new problems growing out of the reform, many scientific research units did not hesitate and did not rely on superior agencies but adopted bold reform measures. Hefei General Mechanical Engineering Institute laid out a temporary regulation in the face of the problem of whether technological staff members should be allowed to accept outside work. The institute decided that technological staff members be allowed to accept outside technological work on the condition that they accomplish their own work in their institute first, and the institute also laid out a guideline to regulate the

approval procedure and work compensation. At present, all scientific research units face a common problem of an aging staff which affects the growth of new blood. Some units have decided not to assign older scientific personnel to administrative positions and let them free out of the cumbersome administrative work, and instead have assigned them to chief engineer positions to concentrate their minds on scientific research. These bold approaches and liberalized thinking are extremely desirable.

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NATIONAL DEVELOPMENTS

ELECTRICAL INSTITUTE IMPLEMENTS PART-TIME EMPLOYMENT SYSTEM

Shanghai WENHUI BAO in Chinese 23 Jan 85 p 1

[Article by Le Di [2867 6611] "Electrical Technology Institute Implements Two-Way Part-Time Employment System"]

[Text] Shanghai Electrical Technology Institute implements a "two-way part-time" system during reform, and both encourages its workers to find part-time work in other places and recruits employees of other places to work part-time at the institute; by doing so it fully taps the potential of its workers and fills in the gaps that exist in different specialties within the institute. In 1984 the institute had only 60 percent of the fully authorized number of staff scientific and research workers, but accomplished 125 percent of the scientific and research tasks assigned to them, of which two items of theirs filled the vacuum for the whole nation.

The institute has a very short history, its technological manpower is weak and it lacks certain types of specialized talented personnel. Two years ago, during the research and design of "UPS electric source", the institute did not have enough technical personnel to solve some of the obscure problems, they went to Nanjing Engineering College and Luzhou Chemical Plant to invite guest engineers to attack the problems together. As a result, the institute not only completed the scientific research task in time, but also filled a vacuum for the nation and made the product its flagship. This experience inspired the leadership of the institute, and the guest engineer program was adopted and expanded within the institute. Following the transfer of the technological results, some research workers at the institute requested to use their own after-hour time to work for other units, and the institute leadership approved their requests on the condition that they completed their work within the institute first. Last September, the institute took "two-way part-time employment" matter as one of the items for reform and formally instituted it as a system.

Specifically, the two-way part-time employment" system is that scientific research specialists within the city or in other provinces and cities can come to the institute to work as technological advisers or guest engineers when they are needed. Those who have difficulties coming to Shanghai to work can be correspondent engineers. According to the practical needs of the institute, part-time employment at the institute can be long term or temporary. Scientific research workers of the institute may seek part-time work at other institutes

if they have completed the institute's contracted research works, or part-time work may be arranged for them by the concerned units of the institute. Part-time employment activity with the consent of the leadership will not be governed by the 8-hour work schedule. For the moment, the institute and several research departments have invited over a dozen of part-time advisers from Zhejiang University and other organizations; it also has some key technical personnel to work part-time in plants in Shengxian County, Zhejiang Province and at the Pujiang Switch Factory in Shanghai--to give assistance to neighborhood and rural enterprises. "Two-way part-time employment" activity has stimulated the electrical institute's research and management developed new products and opened up new research horizons. Guest engineers from other organizations not only supplement its technological strength and solve its research difficulties, but also help it keep some of its highly specialized scientific research personnel. The institute's research workers working part-time at other units also transfer some of its research fruit to others and bring back some income for the institute in return.

Shanghai WENHUI BAO in Chinese 23 Jan 85 p 1

[Commentary: Another Way to Tap the Potential of Scientific and Technological Personnel]

[Text] Shanghai Electrical Institute not only encourages its scientific and technological personnel to seek appropriate part-time work after they complete their own tasks, it also advocates outside scientific and technological personnel to work for the institute on a part-time basis to solve its shortage of technological personnel. This kind of practice is worth promoting.

The institute's adoption of the "two-way part-time employment" system strengthens the horizontal contacts between institute and institute and between the institute and the society and is an important measure for developing the potential of intelligence. It both encourages scientific and technological personnel to fully develop their potential and overcomes the institute's "small and complete" problem. It can work in coordination with other institutes to solve the problems it lacks in skill. This approach will have a positive effect for better serving the construction of the country by expanding both the exchange of academic knowledge and cooperation on important technological tasks. at the same time, this method will conserve the research expenditures of scientific research units. Under the current circumstances of our country's shortage of professional personnel and lack of funds, adoption of the "two-way part-time employment" system by some institutes under certain conditions should be seriously regarded and given positive support.

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NATIONAL DEVELOPMENTS

DESCRIPTION OF MICROCOMPUTER LAN IN ELECTRONICS MINISTRY

Beijing DIANZI JISHU YINGYONG [ELECTRONICS APPLICATIONS] in Chinese No 2,  
25 Feb 85 pp 6-8

[Article by Fan Xitian [5400 3556 1131], Gao Yufang [7559 7183 5364], and Wang  
Guanghai [3769 2710 3189], the China Computer Service Company: "The Ministry of  
Electronics Organization Management Network System"]

[Text] Overview

The task of the Ministry of Electronics Computer Management Network System is to carry out tasking management within ministry organizations, and to help functionary offices and departments handle information. This is a management system that has as its goal the aiding of decision making, and therefore there is a great deal shared with professional management systems in design philosophy and in the process of project realization. Thus, this system has definite value for extended adoption.

This information management system uses the OMNINET local area network [LAN], with a total of 13 workstations (using 13 IBM-PCs). Its structure is shown in Figure 1.

The workstations are distributed over three three-story buildings.

The chief functions of the system are:

periodic collection and arrangement of data reported from lower levels, and timely response to all inquiries;

long term preservation of relevant materials;

provides relevant complete information to decision making departments;

simple arrangements for planning.

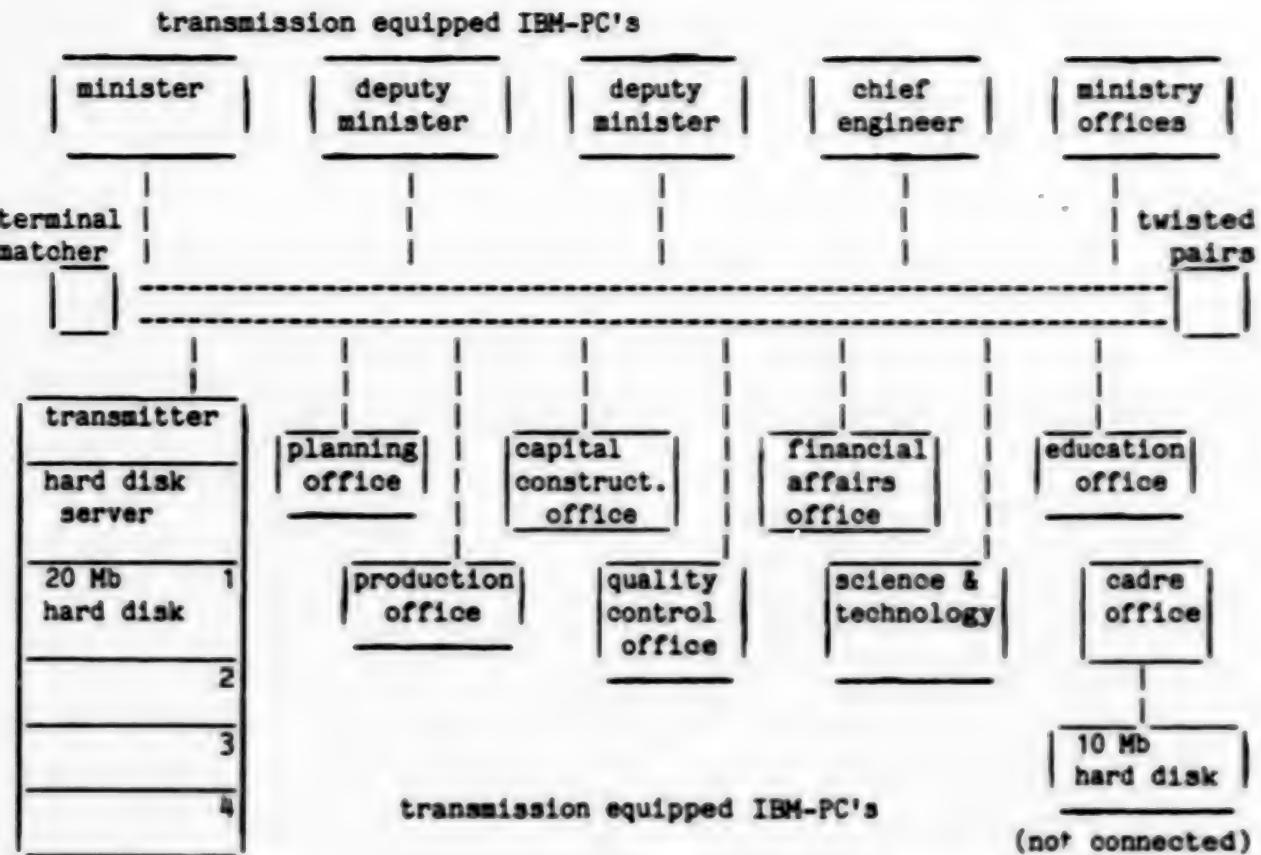


Figure 1 Schematic Diagram of the System Structure

Particular things that the computer system is required to do:

1. Data recording, editing, and revision.
2. Re: data processing: calculation, statistics, categorization, selection, arrangement, search by keys, queue, integrate, edit, and make reports.
3. Information search: find a particular category of data, find particular pages of data that one wants to read, print, add to, revise, or delete, find complete data that satisfies certain particular requirements, and provide information in a specific format as required.
4. Information storage: according to the user's requirements, save relevant information in various media (hard disk, floppies, hard copy, etc.).
5. Resource sharing: share data that has been saved on the hard disk, according to certain rules.
6. Determination of limits to data access: allocate the space in which data may reside and implement data privacy requirements.

7. Transmission of data between work stations.

8. Output of information.

This system accomplishes management of the following areas:

Conditions of enterprises and public agencies directly affiliated with the Ministry of Electronics; relevant groups, organizations, and personnel rosters; telephone directories; ministry annual surveys; agenda arrangements for ministry leaders; monthly report on production of old products; energy consumption; annual survey of capital construction; equipment survey; financial office monthly (quarterly) report; collection of planning statistics (gather chronological tables for production output values, output amounts, etc.); annual status of national and ministry level top quality products; contracts and rate of progress for particular specialized products; 16 economic indexes; the situation regarding new products in ministry scientific research; situation for ministry design of new products; cadre situation reports, etc.

**Design Philosophy and Its Application in This Management System**

The key to management is decision making. We believe that there are at least five key links in decision making:

1. There should be several ways of dealing with a situation, that is, there should be many programs from which to choose;
2. There are clear standards for the optimal ways of dealing with things (like having economic results, personal safety, political or educational results as the standard, etc.);
3. There are quantitative comparative analyses, standards should be quantified for ease in numerical processing;
4. The decision making cycle should be short, that is, results should be sought quickly, to allow decision making to come before events;
5. There should be feedback handling, for timely adjustment of policy making (or for producing new policies).

Among these, the most important are quantifying and speed, and the computer can perform excellently in these links. We have set up a "multi-element chart" (see figure 2) to explain the penetration and full degree of computer application systems and service in management.

We have approached decision making from the three different angles ("three elements") of enterprise information structures, computer management levels, and the process of information processing. Each element could be further divided into several levels.

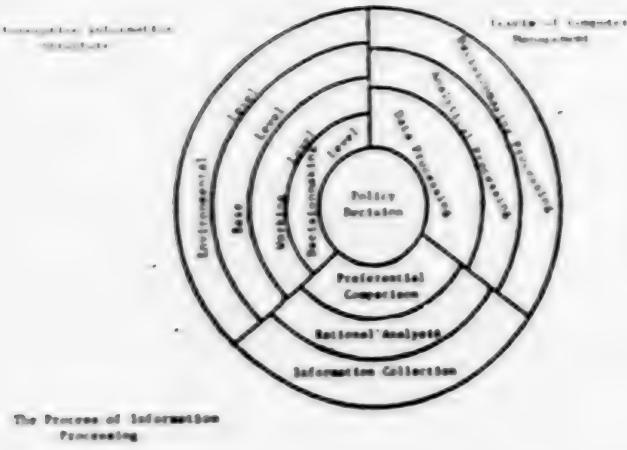


Figure 2 Multi-element Chart for Computer Management

Enterprise information structures reflect an information flow hierarchy within the enterprise. In the average department these may be divided into base level, working level, decision making level, and environmental level. By the base level we mean the first line of production activities, which is the basic source of information; the working level is the department's middle level management structure, it is the chief position in information management, and is also a collection and dispersal point for information; the decision making level is the leadership structure in the department, what ought to be sent here is information that concerns the whole picture, which is the basis for the decisions made by the leadership; the environmental level means information granting and receiving units not under direct control of the enterprise in question. A computer management system ought to serve those levels, which must be determined by the needs and level of the user, as well as the capabilities of the computer system that can be provided. In initial applications of computers the majority are first used at the decision making and working levels, and then are gradually extended after experience is gained or when there is more powerful hardware or software.

The levels of computer management indicate the degree to which computers participate in management in enterprises or in departments. We have divided this extent into three levels: data processing (initial level). The questions it answers are: what is the current situation; analytical processing (middle level), the question it responds to is: based on the current situation, what will be the results; policy making processing (highest level), and the question it addresses is: based on the current situation and the possible results, what effective (i.e., reasonable, personally satisfying or optimum) policies ought to be adopted. Obviously, these three types of processing are hierarchical, while analytical processing and policy making processing are not only related to the design of the system, but even more are related to the level and ability of the user to use information, and is related to the extent the user has mastered his own working rules (programming, mathematics).

The process of information processing refers to steps adopted toward information from entering the computer system to the final stage of

processing. In general this is divided into the three steps of information gathering, rational analysis, and preferential comparison. Information gathering is to process situations relevant to management policy according to certain goals and with certain methods and make them into several parameters that can reflect the essence of things, that is, to screen and initially quantify the information sent along from the sources of information. Rational analysis uses mathematical tools and relevant theories from management science to process information with a base of scientific theory, where the results are complete in nature. Results of this sort can already be provided to decision makers for their use. Preferential comparison, then, is further handling based on the results of rational analysis, which derives several different policies and programs for final selection by decision makers.

Clearly, these kinds of "multi-element" analyses are mutually related. For example, if we ask that the computer system assume analytical processing tasking, then we want to be sure to have completed the process of rational analysis.

After proposing the "multi-element chart," we can more easily provide a certain scope to the design of the information management system, and make a multiple aspect measure to evaluate the degree of management tasking to be executed by the computer. Speaking of the network system currently in the Ministry of Electronics, which does only about 50 percent of the tasking in the "multi-element chart," this computer system serves only the decision making level (ministry leaders) and the working level (the various functionary offices and departments), as shown in figure 3. The levels of management are limited to data processing, and do not yet include analytical processing and decision making processing; the information handling process has also only preliminarily entered levels outside of rational analysis, that is, it only does certain calculations, statistics, categorization, storage, and retrieval, and does not use mathematical modeling and management science for more complicated processing, nor even less does it propose various policies for selection. These items await further experience for continued polishing.

**Some Impressions from Experience Regarding the Implementation of this Project**  
Implementation of this project was carried out in accordance with the general principles of systems engineering, in all four stages.

The first stage: produce analytical reports on the feasibility of the project and recommendations on these items.

Based on the requirements proposed by the Ministry of Electronics regarding project time limits, scope of management, job requirements, and information characteristics (rate of information flow, amount of storage, speed of requested response, the most fundamental data needed by decision makers), including the user situations regarding possession, utilization, and modes of handling for the information in question, equipment provisions possibilities, operating characteristics for ministry organizations, and environmental conditions, we felt that using a microcomputer local area network was the most suitable. The reasons were that tasking by various ministry organization offices is relatively dispersed and independent, with few lateral relations,

but ministry leaders require timely and varied information from all offices while the quantity and time requirement are also somewhat less than those of other large departments (as for example the Ministry of Metallurgy, the Ministry of Coal Mining, the Ministry of Railroads, etc.). We compared the current hierarchical situation at the Ministry of Electronics to the "multi-element chart," proposing the scale of this system as discussed above and the system functions decided upon.

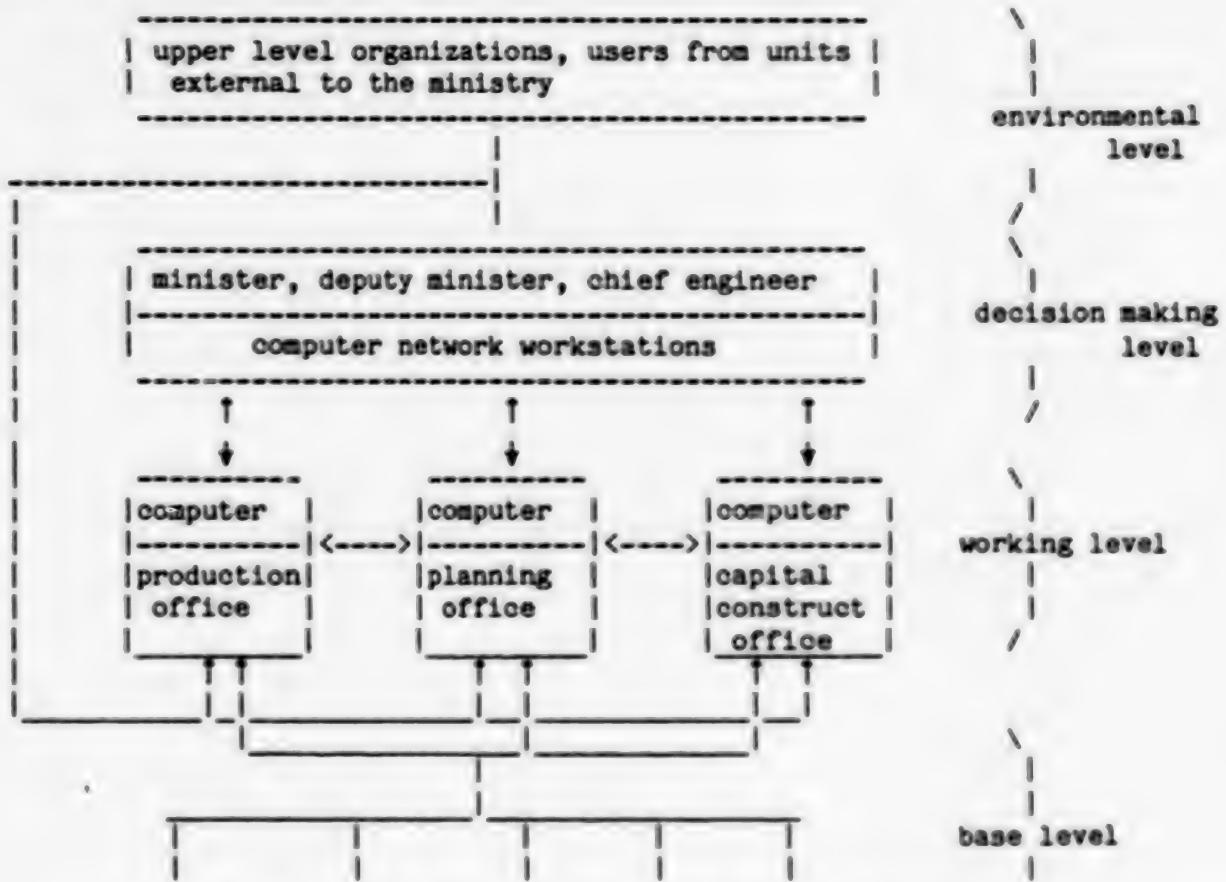


Figure 3 Structural Pattern for Information Flow Within Ministry Organizations and the Service Range of the Management System

At the first stage we had to first clearly respond to whether or not the aspects of system hardware, software, project rate of progress, and practical value were acceptable. Therefore, this required that those technicians participating in the work have a certain actual engineering experience and ability for systems analysis. After preliminary research we produced an overall program and recommendations on these subjects.

The second stage: the process of examination and approval. That is, discussion and written replies to feasibility analysis reports and the overall program recommendations. The most important matter at this stage was determining the overall program for the items, including the determination of type of computer, software to be used, technical indexes, rate of project

progress, testing criteria, overall budget for expenses, person in overall responsibility for the project, etc. Not only technicians took part in this stage, but also users and leaders from engineering responsibility units, who approved the basis for the project's various "rules."

The third stage: implementing the overall program. Most outstanding at this stage was the question of time, which required that as the project progressed and as each item was completed, more technicians were required to take part. This stage was completed in two time periods. In the first, the project only did the work of hooking up the computers at the decision making level to the network, that is, connecting the five work stations of the minister, the deputy minister, the chief engineer, and the ministry office. This stage is the one of implementation, beginning with using a Chinese disk operating system, restructuring the software to use Chinese characters, and solving key technical questions. In this way, both we and the users each had some experience, and laid a foundation for full scale unfolding of the second period project. The second period project was to link up the workstations in the other offices and departments, the amount of work for which being from 5 to 7 times that of the first period. We have currently finished the connections for the production office, office of financial affairs, and the office of capital construction, the entire project to be finished by the end of 1984.

The extent of the entire system project includes: system analysis, changing existing software to be used with Chinese characters, design and debugging of applications programs (programming, branch calls, general calls, data input, testing of applications programs), system set up and field restructuring (field checking and construction), user training, writing of technical documents, maintenance during test operations period, acceptance check, etc.

The fourth stage: an acceptance check of the entire project.

From design to construction of this project we paid special attention to the implementation of the following principles:

1. Serve the user.

There are three ideas behind "serve the user": consider technical requirements together with the user. Because there is possibly a difference between our knowledge of computers and the user's knowledge, the requirements considered could be greater or less. If they were to be higher that would be difficult to implement all at once in the project, which point should be explained clearly to the user; were they to be less, that would be easy to implement in the engineering, but to fully realize the potential of the computers we ought to help the user consider this more thoroughly. The second is that in writing programs we should make things as convenient as possible for the user. Therefore, we used a "menu" system, allowing the user to select the functions he needs. In providing various functions we tried as hard as possible to reduce Chinese character input, so we used the dBASE II relational database as a tool, and in this way the user could easily learn how to use and maintain the system, as well as allow the system to be even more general purpose. The third sense of "serving the user" has to do with suggesting improvements to

the user after understanding the needs of the user and conditions under which information is used.

2. Practicality. The starting point for this networking system was to allow the ministry organizations to use computers for management as quickly as possible. From the point of view of our current level, were we to use larger scale, more advanced computer systems, the intellectual preparation of the users would perhaps be insufficient. Also, time needed to implement the system would be longer. Therefore, it is more practical to first use small systems to manage a portion of an organization's workload and wait until the users have had more experience in quantified information use before constructing more advanced systems. The current network can serve as a bridge to the larger systems that will be used in the future. Even in the future this kind of system will still be within an office.

3. Universality. When designing this system we considered its universality and commercial nature. This management system is general purpose in the aspects of system analysis, network communications, security measures, and typical applications modules. After understanding the program structure of this system, one can conveniently transfer that knowledge to using dBASE II for applications in other departments.

4. In the process of project implementation give full play to the combined talents of the technical personnel. Regarding strengths, levels, and experience among personnel, we used different combinations at different stages, which was more advantageous to the implementation of the project.

There are several insufficiencies still in the system, both internal and external storage capacities are small and operating speed is low, so that when used for a great deal of data processing the efficiency is not ideal. Chinese character printing is done with dot matrix printers, and when printing a large number of reports one has the feeling that it just cannot do enough. It would be best to use laser printers.

#### **System Application Results**

When ministerial organizations use computers for management, economic results are not generated directly in that department, but are chiefly in improving the accuracy of decision making and work efficiency among leadership organizations. Specifically, this is apparent in:

1. Because quantified information is the base, the information that decision makers can become aware of is more realistic and accurate, and they can make decisions that are more reasonable and more perfect.
2. Whether it is the time for making decisions or time for handling feedback, both are reduced over the former time, and consequently the time for making decisions is shortened.
3. Preservation of information is more widespread and effective, and it can be called in at any time by decision making centers to respond to inquiries.

4. It has reduced the shelving and obstruction of information. There have been obvious results especially in reports, numbers, and plan arrangements of a daily nature.

5. Use of the computer management system will advance further restructuring of the ministry organizations and allow them to take a great step toward the direction of modernization, which is a very important point.

This system is already working in the offices of the minister, the deputy minister, the chief engineer, and the general office, the production office, and the office of capital construction.

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NATIONAL DEVELOPMENTS

CURRENT STATUS, PROGRESS OF PHYSICAL ORGANIC CHEMISTRY IN CHINA

Shanghai YOUJI HUAXUE [ORGANIC CHEMISTRY] in Chinese No 1, Feb 85 pp 107-112,  
inside of back cover

[Article by Department No 10, Shanghai Institute of Organic Chemistry, Chinese  
Academy of Sciences]

[Text] Abstract: An overview of the current studies in all major areas of physical organic chemistry is presented. The importance of physical organic chemistry as a basic science and its development both in depth and scope in the past decades are emphasized. The major progress in this field in China are briefly discussed with reference to the first and second Symposia on Physical Organic Chemistry.

Physical organic chemistry is a basic science that studies the structures and reaction mechanisms of organic compounds by applying the concepts, theories and methodologies of physics and physical chemistry. It provides theoretical basis for organic chemistry as well as polymer chemistry and biochemistry and is the most active and important area of organic chemistry[1-3]. The main contents and technical basis of physical organic chemistry studies have been reviewed and will not be repeated[1-2]. As we all know that physical organic chemistry, like other basic natural sciences, has been advanced in both depth and scope during the past decades. Some traditional, "old" problems are still being studied with great vigor and there are plenty of significant tasks to be done.

The basic content of physical organic chemistry is the study of reaction mechanisms. Further refinement of the qualitative model widely used by organic chemists--the concepts of transition state and intermediate--will continue to be an important subject for a long time into the future. According to this model, a reaction mechanism refers to the identification of all intermediates in a reaction and the correlation of all transition states of reactants, intermediates and products and their energy states. The current studies of reaction mechanism, on the one hand, are focused on the discovery of new types of mechanism such as the recent investigations of single electron transfer reactions[4, 5] but, on the other, the majority of work remain to be the in-depth studies or re-investigations of the known reaction types, which include the study of the dynamic processes of intermediates and transition

states and the impacts of structural and environmental effects on reaction processes. Chemical kinetics still is one of the regularly used tools in the study of reaction mechanism<sup>[6]</sup>. With the constant improvements of kinetic methodology and the use of computer in data processing<sup>[7]</sup>, the future kinetic studies will increase in volume and probe deeper into the elementary processes of reactions and their "microscopic rate constants," which are very important to the understanding of the dynamic processes of reactions.

The study of the types and structures of reaction intermediates and transition states is a "classical" area of common interests in physical organic chemistry<sup>[8, 9]</sup>. The reactive intermediates that have been discovered include free radicals, carbanions, carbonium ions, anionic groups, cationic groups, carbenes, nitrenes(:N-), arynes and ylides. Based on the type of reaction intermediate, this area of study is often classified further into such categories as carbonium chemistry, carbanion chemistry, free radical chemistry, carbene chemistry and the concerted reaction involving only one transition state. The direct observation of reactive intermediates is the most important accomplishment. Also, notable progress have been made in studying the influences of environment, media and outside ions on the reactivity of intermediates. Examples are the behavior of carbonium ions in superacid, the gegenion effect and the issue of carbenoids in carbanion chemistry. The ongoing debate that has lasted for 20 years concerning the issue of non-classical carbonium ion has become clearer<sup>[10]</sup>. However, it is still unclear as to the problems of energy degeneration, transition and difference in reactivity between the singlet and triplet states of diradicals<sup>[11]</sup>, carbenes<sup>[12]</sup> and nitrenes<sup>[8]</sup>. Studies on the excited states of general reactive intermediates and some low-valence species such as carbynes have just begun. Due to their implications in understanding the mechanism of single electron transfer reaction, the anionic and cationic intermediates have been actively studied.

The most studied single electron transfer reaction is the chain reaction of free radical nucleophilic substitution, whose mechanism was first reported by Korblum and Russel and later named  $S_{\text{N}}1$  by Bunnett<sup>[5]</sup>. Such chain mechanisms as the chain substitution reactions  $S_{\text{N}}2$  and  $S_{\text{N}}1$  involving the cationic group C<sup>+</sup> and the biological oxidation processes that involve single electron transfer have increasingly been studied<sup>[13-15]</sup>. At the same time, there is a rapid surge in the number of studies on the SET reaction<sup>[13-15]</sup>, which is a non-chain process and has been found to exist in such reactions as Grignard reaction, metal-catalyzed oxidation-reduction, aromatic nitration, Aldol condensation, Claisen condensation and the decomposition of peroxides<sup>[16-17]</sup>. With steady progress in the experimental and theoretical studies of this problem, it can be anticipated that connections will be made between the two major reactions in organic chemistry, i.e. the ionic reaction and reaction of neutral species (e.g. free radical, carbene and pericyclic reaction.)

The structure-activity relationship is a topic that has been widely studied since the infancy of physical organic chemistry<sup>[18-22]</sup>. The linear free-energy relationship proposed by Brostod and Hammett still serves as the major theoretical basis for the majority of scholars active in this field in their way of thinking. The method of relationship analysis is no longer limited to

the study of substitution effect on reactivity. Instead, it is also widely applied in the study of solvent effect, various spectral parameters (particularly the chemical shift values in NMR) and the structure-activity relationship problems in biochemistry and medicinal chemistry.

The most important area in the investigations of environmental effect is the solvation of ionic species. Significant advancements both in theory and application have been made in the study of polar aprotic solvents, which greatly enhance the study of media effect[23]. The proposition and development of the concept of ion pairs in solution and the emergence of crown ethers and phase transfer catalysts are all the direct consequences of these studies. Recent results on gas-phase ion-molecule reactions reveal that our understanding of solvent effect is either insufficient or erroneous in many aspects and must be re-investigated. The quantitative study of solvent effect has resulted in tens of empirical parameters of characteristic solvent polarity and other properties and their relationships with reaction rate, equilibrium and spectral properties being proposed[24]. Similarly, investigations on the influences of organized environments such as liquid crystal, colloid, vesicle, crystal and boundary, backbone, template and host-guest complexation on the properties and reaction processes of organic compounds have been increasingly active[25-29] and become the other important area in the study of environmental effect. Impressive progress have been achieved in the short history of the host-guest chemistry, which is considered one of the most important new areas[30-33].

In this era of rapid advancements in sciences, particularly noteworthy is the emergence of many integrated research areas due to the mutual penetration and overlapping of disciplines. Thus, the issue of extending the scope of physical organic chemistry directly involves some frontier areas and overlapping borderline or branch areas.

The combination of physical organic chemistry and biochemistry constitutes an important borderline area. Studies in this area can be roughly divided into two aspects. One is the direct study of biomolecules and biological systems by the concepts and methodologies of physical organic chemistry in order to elucidate the mechanisms of biochemical processes. The other is the construction of relatively simple model systems to mimic partially or totally a certain biological process, the most significant among them is the mimicking of enzyme and membrane functions. Generally speaking, for nearly every type of reaction occurring in life systems, clues can be found in the reaction mechanisms that have been studied in physical organic chemistry. For example, the acid-base catalysis of carbonyl group is the basis for the understanding of hydrolase catalysis mechanisms. Recently, detailed studies of free radical reaction and single electron transfer process in biological processes have been or are being carried out. Physical organic chemists have also actively participated in the studies of such important biochemical processes as co-enzyme chemistry, oxygen metabolism, photosynthesis, nitrogen fixation, template reaction, carcinogenic and anti-cancer mechanisms, immunological process and the chemical reactions involved in taste, smell and neural transmittance. One of the important present and future research areas is the

chemical simulation of enzymes or the artificial enzymes. Through the synthesis of some small-scale model compounds of enzyme, it becomes very attractive in both theory and application to chemically mimic partially or even totally the functions of certain enzymes. So far only very low catalytic efficiency has been observed in the organic reactions catalyzed by colloid systems. It is possible to raise the co-catalytic activity and specificity by synthesizing polyfunctional surfactants and by altering the composition and structure of colloid systems. Recently, catalytic properties similar to those of chymotrypsin have been observed by introducing appropriate functional groups on the backbone of cyclodextrin<sup>[34]</sup>. The most notable progress in this area is the macrocyclic model compound of enzyme reported by Cram that approaches the catalytic efficiency of the enzyme(10<sup>11</sup>)<sup>[43]</sup> in acylation. However, under all circumstances, the specificities of these model compounds are far from those of the genuine enzymes.

The organo-metallic chemistry, particularly the transition metal chemistry, has been steadily advancing. New compounds, new structures and new reactions are emerging in an endless stream. Nevertheless, the understanding of their reaction mechanisms and structure-activity relationships are still rather immature. Currently, attentions are focused on the study of the elementary reactions that have general implications in organo-metallic chemistry. Those elementary processes that have been confirmed include the association and dissociation of coordination complex, oxidative addition and reductive elimination, insertion and elimination reactions as well as the reactions involving the coordination complex of metals. It is still far from clear as to their mechanisms, the key issues of which include the formation and cleavage mechanisms of M-C<sub>6</sub> bond and the factors influencing the strength and cleavage mode of M-C bond. It worths mentioning that recent results have shown that the free radical mechanism of single electron transfer process is involved in some organo-metallic reactions.

Therefore, more studies have to be done to determine whether the above-mentioned "elementary reactions" are really elementary. On the theoretical aspect, Hoffman recently proposed the concept of isolobal analogy<sup>[35]</sup>, which has significant implications in understanding and predicting the properties and reaction mechanisms of complicated organo-metallic compounds and cluster compounds. It probably will become an important theoretical concept that bridges inorganic and organic chemistry.

Theoretical organic chemistry serves as one of the theoretical basis of physical organic chemistry while the concepts and calculation methods of quantum theory and statistical mechanics as important tools. Many subjects that initially belong to the domain of chemical physics or physical chemistry are quickly picked up by physical organic chemists, who then make their own contributions in the further development and application of them. Closely combining theory with practice is one of the specialties of physical organic chemist. The qualitative theories based on the basic principles of theoretical chemistry have been widely applied in physical organic chemistry studies, the Woodward-Hoffman rule on conservation of orbital symmetry being the most famous example. In recent years, there are great success in studying

reactivity, substituent effect and the stereoselectivity and regioselectivity of ring addition reactions by applying the perturbation theory and frontier orbital approximation of orbital interaction developed by Dewar, Salem and Fukui. Klopman further introduced and applied the concepts of "orbital control" and "charge control" to hard-soft acid-base reactions as well as nucleophilic and electrophilic reactions. The impact of the qualitative valence bond theory and the unified valence bond theory, proposed by Epiotis, Shaik and Pross, on the calculation of reaction potential energy surface and the application of an empirical valence bond method, proposed by Warshel, in the calculation of reaction potential energy surface in solution should also be mentioned. How to make quantitative or semi-quantitative estimations of reaction activation energy by simple calculations remains an important and challenging topic.

Because physical methods play important and at times decisive roles in physical organic chemistry, the areas of interest of physical organic chemists have been expanding to include the development and improvement of instruments, technologies and related theories in physics. Nuclear magnetic resonance is currently the most important and most promising analytical tool. The amount of information it gives out is unsurpassed by any other spectroscopic methods. It can be used to study stable molecules and to observe such reaction intermediates as carbonium ions, carbanions, free radicals, carbenes and the intermediates containing N,S,O,P and metal atom as well as to obtain such dynamic structural information as conformational change, configurational change and rapid transition. In recent years, the NMR technique has shown tremendous power in studying the dynamic processes of reaction. New NMR techniques are currently being developed in rapid succession, which include: a) The emergence of NMR spectroscopy of various isotopes<sup>[36-38]</sup>. The <sup>13</sup>C NMR has become a routine analytical method while the NMR techniques of other nuclei are being rapidly developed, the <sup>15</sup>N NMR, <sup>17</sup>O NMR and <sup>2</sup>H NMR being particularly important to organic chemistry. b) The rapid development of dynamic NMR (DNMR) technique in recent years<sup>[39]</sup>. DNMR can be used to study dynamic structures such as conformational change, all kinds of transformations, exchange reactions, rearrangements, exchange between triplet and ground states and other fast chemical processes. c) The chemically induced dynamic nuclear polarization (CIDNP) technique can be used to study the reactions of free radicals, carbenes, diradicals and photo-excited molecules as well as electron transfer processes. d) Significant breakthroughs have been achieved on solid-state NMR technique so that it is possible to produce high-resolution spectra that are comparable to liquid samples in resolution<sup>[40]</sup>. e) The time-resolved NMR technique, shifting reagents and the NMR measurements in organized environments (e.g. liquid crystal and adsorption surface) are all useful for obtaining structural information. The paramagnetic resonance (ESR or EPR) is the most important spectroscopic method in free radical chemistry and has played an important role recently in the study of SET reactions. By ESR, Ashby has confirmed that the single electron transfer mechanism might be involved in such old but important reactions as Grignard reaction, Aldol condensation, Claisen condensation and Cannizaro reaction. The ESR has also been generously applied to study biological systems. The recently developed double-resonance technique, low-temperature measurement technique and chemically induced dynamic electronic polarization (CIDEP) technique have further extended the range of application of ESR

technique. The fast Fourier-transformation technique helps realize high speed, high sensitivity and high resolution in IR spectroscopy and make it suitable for examining reaction processes. The time-resolved IR spectroscopy may be used to observe fast processes in the range of  $10^{-12}$  second. The electron spectroscopy (ESCA) is a powerful weapon for measuring energy levels of molecules and ions but technical improvements are necessary for more refined spectra. The combination of the FT technique and the spectroscopic technique of various wavelength ranges using laser as light source has revolutionized and will continue to revolutionize spectroscopic techniques. All kinds of two-dimensional Fourier-transformed spectroscopies have tremendous potentials. The 2D Fourier-transformed NMR spectra have been obtained that are obviously superior<sup>[41]</sup>. The ion cyclotron resonance (ICR) spectroscopy, high-pressure mass spectroscopy and flowing afterglow are major means for studying gas-phase ion reactions. The improvem

The improvements of these methods and the search for more powerful technologies are important tasks in this area. The photo-electron energy spectroscopy has been shown to be a promising technique and more and more attentions are directed to methods for studying fast kinetic processes. The currently popular methods are relaxation methods such as supersonic relaxation, temperature shift, pressure shift, electric field shift, flash photolysis, fluorescence quenching and spin-relaxation measurements in NMR and ESR. The rapid developments of picosecond spectroscopic technique will cause fundamental changes in the measurement techniques of fast kinetics. The applications of other spectroscopic techniques such as coherent anti-Stokes Raman spectroscopy (CARS), laser-induced fluorometry, (e,2e) spectroscopy, electron diffraction and energy loss spectroscopy and emission circular dichroism are increasing. Also the neutron diffraction and synchotron radiation, tunable infra-red and ultra-violet laser techniques have their potentials.

In the mean time, synthetic organic chemistry has broken new ground. The synthesis of new molecules having particular theoretical significance or special properties have provided new targets for physical organic chemistry research. The major types of these molecules include the highly-strained cubane and tetrahedrane, cyclobutadiene, annulene, kekulene and tropylium ion that are either aromatic or anti-aromatic, species with special valence bond such as the super-coordinated compounds of CHs, S and Br, molecules with special properties and functions such as super acids, bases, organic conductors, crown ethers, crypt ethers and the synthesis of special host compounds and enzyme models. The latest accomplishments in this area are the successful synthesis of cage-structured dodecahedrane<sup>[42]</sup> and the synthesis of an artificial enzyme that approaches the enzymic catalytic activity<sup>[43]</sup>.

In our country, due to the interference of erroneous thinkings, physical organic chemistry research has been for a long time almost non-existent. This situation blocks not only the progress of the discipline itself but also the elevation of scientific level of other related fields and indirectly affects the elevation and development of industrial and technological level. Not until after the smashing of the "gang of four" was physical organic chemistry included for the first time in the 8-year plan as one of the key disciplines to be developed.

In November 1981, the first Symposium on Physical Organic Chemistry was held in Guilin<sup>[44]</sup>, depicting the new results obtained in the field around that time.

Through the long term study of organic natural compounds and employing the principles of physical organic chemistry to elucidate mechanisms and study structures, it was discovered that, when heating securinine under basic condition, stable product was obtained through the loss of proton with subsequent series of C-N bond cleavages and charge transfers. The study on the optical stability of an alkaloid from *Cephalotaxus fortunei* confirmed the existence of racemization. The quantum chemical calculations on the substituted oxazole derivatives showed a very close correlation among the molecular structure, electronic effect of substituents and photo-characteristics (e.g. laser transition efficiency) of these compounds. Studies on the bridgehead conjugation systems proved that the structure-activity relationship of compounds in this system also obeys the rule of linear correlation of homologs. The relationship between the bridgehead conjugation systems and linear systems was also discussed.

On the aspect of reaction mechanism study, the thermal decomposition reaction of lauroyl peroxide in benzene have been studied and shown to proceed through free radical mechanism. Factors that have effect on inducing decomposition and the influences of cage effect have also been studied. Studies on the structure and property of fluorocarbons have proved that the addition of t-butoxyl group to vinylidene fluoride is bi-directional and thus disproved the conclusion of Kochi's. The study on the ease of formation of perfluoro radicals has been reported for the first time by using the kinetic method of B-cleavage. Based on the  $\beta$ -electron pair rule and single electron transfer mechanism of the heterolytic cleavage of C-F bond, it was discovered that the reaction of certain electron donors (e.g. isopropoxide) and trans-1,2-diphenyl-hexa-fluorocyclobutane gave alkoxyl-substituted products. Studying from the angle of physical organic chemistry the microenvironment effect that plays important role in life processes is a new research area. Using the helical conformation of amylose as a new model system to study its interaction with the hydrophobic long-chain alkyl substrates, the driving force for the formation of inclusion complex from amylose and substrate has been shown to be the hydrophobic-lipophilic interaction. Besides, studies on the hydrolysis of substituted carboxylic esters and the effect of neighboring group participation by using the special helical microenvironment as well as the structure-activity relationship of extractants have been carried out, a highly stereoselective rearrangement of alkynyl ester--vinyl either has been discovered and the substituent effect in the electrophilic substitution reactions of aryl mercury compounds has been studied.

Studies on the 2-methyl-4-aryl-benzo-thiaza-cycloheptatriene have confirmed the existence of a non-planar conjugated structure and that the 7-membered ring of dihydro-derivatives assumes the boat form that is twisted to a certain degree whereas the 7-membered ring of tetrahydro-derivatives assumes the most stable quasi-twisted boat conformation. It has also been discovered that the 4-substituent has greater field effect on the nature of nitroxide radicals.

Attentions have been paid to the theoretical chemistry research. The activation energy of the addition reaction of hydrofluoride and ethylene by ab initio calculations is in good agreement with the experimental value. A good linear correlation has been obtained in studying the structure-activity relationship of homologs by the improved HMO method and the linear combination method of fundamental orbitals. The configuration of intermediate in nitration reaction has been determined and the partial potential energy surface of  $C_6H_4 - NO_2^+$  system constructed by the CNDO/2 method. Furthermore, the simulated potential energy surface of  $C_6H_6 - H^+$  system has been calculated by the improved HMO method, the substituent effect discussed, the ab initio calculations of the carbene dimerization reaction done and significant results obtained in studying the pathways of this reaction.

The second Symposium on Physical Organic Chemistry was held in Hangzhou, 15-19 September 1984[45]. This is another grand meeting in the field of physical organic chemistry since the first Symposium in November 1981. The meeting clearly showed more rapid progress in our physical organic chemistry research. In this meeting, the number of paper presented increased to 113 from 71 in the previous one and the number of delegate increased from 107 to 133. Compared to the previous meeting, the quality of papers, the areas covered and the applications of new technologies and methodologies were further raised and more extensive. Papers presented in the meeting covered the three major areas of physical organic chemistry: 1. The dynamic process study of reaction mechanism and kinetics in organic chemistry. 2. The applications of structure-activity and various spectroscopies in organic chemistry. 3. Theoretical organic chemistry.

For example, based on the large volume of work done on organophosphorus extractants, the rule on structure-activity relationship of the extractants has been elucidated and encouraging achievements obtained in guiding their production. More extensive studies on the impact of hydrophobic-lipophilic interaction on chemical reactivity have been made that result in the discovery of the phenomenon of 17-membered ring neighboring group participation in cluster promoting solvents, which has generated interests in chemical circles worldwide. A preliminary new way of measuring the substituent effect parameter  $\sigma$  in free radical reactions has been established. The study of the structure-activity relationship of double fluorescence emission chromophores and the study of laser dyes have become more extensive. The use of such advanced spectroscopic techniques as CIDNP and paramagnetic resonance to study the more complicated free radical reaction mechanisms signifies the accomplishments in the frontier areas of physical organic chemistry by our scientists. In addition, significant, further progress have been achieved in the study of the linear correlation of homologs, the study of aryl mercury compounds and the study of isomerization interconversion. On the aspect of theoretical organic chemistry, the organizations concerned have closely combined quantum chemistry with experimental chemistry to obtain some results in the study of quantum chemical theories that is focused on the elucidation and prediction of reaction mechanisms and structure-activity relationships. Examples include the determination of geometric configurations of chemical reaction intermediates by the energy gradient method, the study of chemical reaction pathways by the "intrinsic

coordinates method" and the study of aromaticity of compounds by matrix calculations. A large number of paper involved the applications of modern physical instruments like dynamic nuclear magnetic resonance, paramagnetic resonance, cyclic voltammetry, Mossbauer spectroscopy and electronic energy spectroscopy, which further enhance our physical organic chemistry research.

The abundant accomplishments in our physical organic chemistry field are the results of the unremitting efforts of the large number of scientists and technicians in our country and of the implementation of party's correct science and technology policy. What is very comforting to the older generation scientists is the fact that, in addition to the young and middle-aged key members at universities and research organizations who continue to produce more and better results, a large number of visiting scholars to foreign countries and graduate students trained domestically are quickly becoming the key forces in scientific research. We have successors to carry on the physical organic chemistry research and a flourishing and excellent prospect is certain to come.

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CSO: 4008/1061

NATIONAL DEVELOPMENTS

ACADEMY OF SCIENCES TO FIND RESEARCH PROJECTS

OW230801 Beijing XINHUA in English 0710 GMT 23 Aug 85

[Text] Beijing, 23 Aug (XINHUA)--The Chinese Academy of Sciences will allocate special funds for basic and applied research projects starting this year, an academy source said here today.

The academy took this step in line with the decision to reform the management of science and technology adopted by the Chinese Communist Party Central Committee in March this year.

Applications from institutes under the academy numbered nearly 1,000 with 110 million yuan required. Review by more than 3,000 experts and specialists led to grants of more than 34 million yuan to 656 research projects.

Subjects include climate change and weather forecasting, quasi-crystalline structure of alloys and measurement of geophysical microwave radiation, with priority for young scientists and institutes in border regions.

The sum for 1986 will be greater and a number of major and comprehensive research projects will be undertaken, an academy official said.

Science foundations will gradually support such projects, with the state providing the institutes with a limited amount for operating expenses and research funds.

CSO: 4010/2014

NATIONAL DEVELOPMENTS

RETIRED TECHNICIANS HELP SHANGHAI ENTERPRISES

OW292102 Beijing XINHUA in English 1913 GMT 29 Aug 85

[Text] Shanghai, 29 Aug (XINHUA)--Shanghai's Societies for Retired Technicians and Experts numbering 3,000 members help enterprises by offering advice to them with technological problems.

The societies charge their clients, and part of the money is paid to the advisers and the rest is used for arranging tours, movies, and other activities for the societies' members.

"The work of the society gives me a chance to contribute to the society," said 71-year-old retired engineer Ding Zhongbao. "Besides, it's good for my health and serves as a kind of remedy for the loneliness one feels in old age."

Retired engineer Yu Weipu, 64, noted that he had found himself again at old age when his advice helped factories in more than 10 provinces and cities make up deficits and increase surpluses.

Shanghai, the largest industrial city in China, at present has 20,000 retired technicians, engineers, architects, accountants, and other experts.

The annual membership fee is about one yuan. The members may translate technological materials at home, provide advice to factories in Shanghai, or tour other provinces and cities for technical guidance, depending on their health conditions and professional skills.

The Yangpu District Retired Engineers Society has sent 150 advice teams in the past year to 20 provinces and cities. The work and guidance of the experts have helped over 50 factories make up deficits and increase surpluses.

CSO: 4010/2014

NATIONAL DEVELOPMENTS

POSTGRADUATE INFORMATION STUDIES COURSE BEGINS

0W021200 Beijing XINHUA in English 0806 GMT 2 Sep 85

[Text] Beijing, 2 Sep (XINHUA)--A postgraduate course in information studies, sponsored by the China Scientific and Technical Information Institute, and partly financed by UNESCO and the British Council, opened here today.

The course aims at training intermediate and senior scientific information and management personnel.

Attending the course are 37 students from China's information departments, archives and libraries. During the 10-month course, they will study 12 subjects, including information and society, information and data sources, management of information systems and services, information content analysis and processing, the marketing and economics of information, information studies methods, and the planning and development of regional and international information systems and networks.

Information specialists from Britain, Canada, France, Japan, Sweden, the United States and UNESCO will give lectures during the course.

Last April, the British Council sent specialists to China to discuss and work out the teaching program.

Director Wang Tingjiong of the China Scientific and Technical Information Institute and Professor Arashinipazat Neelameghan, representative of UNESCO, spoke at today's opening ceremony.

Vice-minister of the State Science and Technology Commission Wu Mingyu, Vice-chairman of China's National Commission for UNESCO Wu Xing and official from the British Embassy here were also present at the ceremony.

CGO: 4010/2014

NATIONAL DEVELOPMENTS

INTERNATIONAL PRODUCTS CATALOG SHOW OPENS

GW031026 Beijing XINHUA in English 0641 GMT 3 Sep 85

[Text] Beijing, 3 Sep (XINHUA)--An international electronics, instruments and meters product catalog exhibition opened here today under the sponsorship of the China Council for the Promotion of International Trade (CCPIT).

On show are more than 1,300 catalogs covering over 270 subjects presented by nearly 70 trade organizations and corporations from Austria, the Democratic Republic of Germany, the Federal Republic of Germany, Ireland, Italy and the United States. They introduce to Chinese visitors new achievements in the electronics, instruments and meters industries.

The exhibition will close 10 September, and then move to Chengdu and Nanjing.

The exhibition is an effective vehicle for introducing information on overseas new products, and a new channel for promoting trade. In addition to a series of product exhibitions, CCPIT has, since 1980, hosted over 70 catalog exhibitions from more than 20 countries.

A CCPIT official told XINHUA, more and more foreign firms and corporations have applied to hold catalog exhibitions in China. International food-processing and textile machinery products catalog exhibitions will be held in Beijing, Xian and Qingdao in September 1986. An Italian corporation also plans a new product catalog exhibition in 14 cities next year.

CGO: 4010/2014

NATIONAL DEVELOPMENTS

HUNAN POPULARIZES MICROCOMPUTER APPLICATIONS

HK240719 Changsha Hunan Provincial Service in Mandarin 1100 GMT 19 Jul 85

[Text] As of now, the Provincial Scientific and Technological Committee has accomplished and put into operation 26 of this year's projects popularizing the application of the microcomputer. Of this figure, 19 are high level and can bring about better economic results, therefore, the projects can increase the province's annual profits by more than 2.8 million yuan.

These projects popularizing the application of the microcomputer are imported in the light of the actual conditions of each enterprise. The projects are highly productive and very flexible. Moreover, they require a small investment and can be started easily.

After applying the microcomputer to information control in formaldehyde production, Hengyang City Chemical Plant No 3 reduced the consumption of methanol in producing a ton of formaldehyde from 460 kg to 440 kg. In the light of the plant's production scale, this can increase its annual profits by 240,000 yuan.

The [Xiangtan] Nitrogenous Fertilizer Plant has used the (Hecheng Cha Weiji) to control the technological processes. The microcomputer is capable of making judgements and sounding alarms based on 40 technological parameters. Therefore, it helps to extend the service life of stored coal and to improve the rate of synthesizing ammonia. Consequently, it has increased its annual output value by 300,000 yuan, and is ranked number one in China.

CSO: 4010/1018

NATIONAL DEVELOPMENTS

BRIEFS

**CESIUM-BEAM ATOMIC CLOCK**--Beijing, 15 May (XINHUA)--A small cesium-beam atomic clock, with an error of less than 1 second in 3,000 years, was made by Zhong Yuan Electronics Technology Research Institute under the Ministry of Electronics Industry. Tests of main technical norms show that the clock is comparable to similar products made in foreign countries. [Summary] [Beijing XINHUA Domestic Service in Chinese 0807 GMT 15 May 85 OW]

**NEW SHANGHAI COMPUTER**--Shanghai, 23 Jun (XINHUA)--After 4 years of hard efforts a new model of a medium-size general-purpose computer has been made by the Huadong Computing Technology Research Institute of the Ministry of Electronics Industry. The new computer, Model 8030, passed the state tests on 23 June in Shanghai. According to experts, this new computer, which is comparable with foreign products in performance, represents a significant breakthrough in China's computer technology. [Summary] [Beijing XINHUA Domestic Service in Chinese 1321 GMT 23 Jun 85 OW]

**JIANGSU ELECTRONICS COMPANY**--The Wuxi Microelectronics Research and Manufacturing Corporation was inaugurated in Wuxi, Jiangsu, on 26 June. The corporation, currently China's biggest integrated research and manufacturing base, is expected to increase the production of integrated circuits in the near future, thus raising China's microelectronic industry to a new level. [Summary] [Nanjing XINHUA RIBAO in Chinese 27 Jun 85 p 1 OW]

**HUBEI MULTIFUNCTIONAL CONSOLE**--Wuhan, 28 June (XINHUA)--The Wuhan Digital Engineering [Shuzi gongcheng 2422 1316 1562 4453] Research Institute in Hubei Province successfully turned out a multifunctional console with a display device, which passed technical tests on 26 June. The console, which consists of medium- and large-scale integrated circuits, is suitable for high-speed calculations. It can also be used in with radar equipment and navigation and air control systems. Experts say its performance is equal to advanced international standards in the early 1980's. [Summary] [Beijing XINHUA Domestic Service in Chinese 1317 GMT 28 Jun 85 OW]

CHINA ACCEPTS FOREIGN PATENT APPLICATIONS—Beijing, 2 Sep (XINHUA)—China's Patent Bureau received 2,821 foreign patent applications from 1 April, the day China's Patent Law went into effect, and 10 August, according to today's SCIENCE JOURNAL. The figure accounts for (731.44) percent of the total applications received, the paper says. A large number of applications have also been addressed to China's patent agencies in charge of foreign affairs. The agencies will relay them to the Patent Bureau, according to the patent agency of the China Council for the Promotion of International Trade. The majority of the foreign applications are related to new inventions, the paper said.  
[Text] [Beijing XINHUA in English 0855 GMT 2 Sep 85 OW]

PATENT AFFAIRS OFFICE—Beijing, 16 Aug (XINHUA)—An opening ceremony for the Patent Affairs Office of the Chinese Academy of Sciences was held in Beijing today. It now formally accepts applications from units within and outside the academy, as well as individuals, to handle matters on patent and related legal affairs. All nine patent affairs offices under the academy opened today simultaneously in Beijing, Shanghai, Shenyang, Wuhan, Xinjiang, and other localities. Lu Jizxi and Gu Yijian, president and secretary general of the Chinese Academy of Sciences respectively, and people from departments concerned, totalling more than 100, attended the opening ceremony. [Summary]  
[Beijing XINHUA Domestic Service in Chinese 0924 GMT 16 Aug 85 OW]

CSO: 4008/2030

APPLIED SCIENCES

CHINA'S FIRST CONTROLLED THERMONUCLEAR FUSION EXPERIMENT DETAILED

Beijing KEXUE SHIYAN [SCIENTIFIC EXPERIMENT] in Chinese No 2, 10 Feb 85  
pp 2-4

[Article by Zhu Zhiyao [2612 1807 1031] and Hu Youquan [5170 2589 3123]]

[Text] "Success!"

The time was 10:15 p.m., 21 September 1984.

In the spacious laboratory hall of the Southwestern Physics Institute located in the suburb of Loshan City of Sichuan Province, the 6-m tall "China Cyclotron No. 1", the first controlled thermonuclear fusion device in China (also referred to as "Project 451") stood in the middle of the hall. Technicians in their white coats, solemn and tense, determined and confident, took up their positions waiting for the arrival of an exciting moment.

"5, 4, 3, 2, 1, contact!" After the roar of the machine subsided, the computer and various measuring instruments began to work, signal lights began to flicker, streams of data were being recorded, and one curve after another were being plotted.

"451 has been started, operation is normal!"

"The vacuum system works well; the vacuum level meets specified requirement!"

"The electric current parameters are rising, and the ring voltage is falling!"

"The plasma waveform has appeared!"

Then, the vacuum meter, the mass spectrometer, the current and volt meters, and the internal vertical magnetic inductance meter all detected the presence of the plasma. It is beyond any doubt that a plasma composed of electrons and deuterons had been created after filling "China Cyclotron No. 1" with hydrogen.

"Success! Success!" Forgetting the many days of intensive labor and exhaustion, people were busy spreading the news and congratulating one another.

By the evening of 26 September, "China Cyclotron No. 1" had undergone more than 3,500 discharge purge tests, and a series of engineering parameters were generated that exceeded the expected target values.

### "Taming the Heavenly Fire"

Just as chemical energy is released by chemical reactions, the huge amount of energy contained in the tiny nucleus can only be released throughout nuclear reactions.

There are two types of nuclear reactions: nuclear fission and nuclear fusion. Fission occurs when a heavy nucleus such as uranium or thorium splits into two nuclei of approximately equal mass when bombarded by neutrons. The energy released from a fission reaction is called fission energy; the fission of 1 kg of uranium can release an amount of energy equivalent to the chemical energy from burning 2,700 tons of coal.

On the other hand, nuclear fusion is a process where light nuclei (e.g., hydrogen or lithium) fuse into a heavier nucleus. The energy released from the fusion of light nuclei is several times larger than the fission energy released by nuclei of the same mass. For example, the energy released by the fusion of 1 kg of hydrogen isotopes, deuterium and tritium, is equivalent to that of burning 10,000 tons of high-quality coal.

Compared to fission, the fusion process is not only more powerful, but there is a more abundant fuel supply. The commonly used fuel for fusion is the hydrogen isotopes, deuterium and tritium, which can be found wherever hydrogen is present; in particular, the unlimited ocean water is a compound of hydrogen and oxygen. The fusion energy of deuterium contained in one barrel of water is equivalent to the chemical energy contained in 3,000 barrels of gasoline.

The ocean water contains 30 trillion tons of deuterium, which is equivalent to  $3 \times 10^{20}$  tons of coal; it provides enough energy for several hundred million years even if the world's energy consumption rate is increased by a factor of 100. In other words, nuclear fuel from fusion can essentially provide an unlimited amount of new energy source. Furthermore, nuclear fusion does not produce harmful radioactive materials; thus, a fusion power station is cleaner and safer than a nuclear fission power station.

But harnessing fusion energy is not so simple. Because all nuclei carry a positive electrical charge, they repel one another; to fuse nuclei together, it is necessary to overcome the huge repulsive force. Under normal conditions, the probability of occurrence of fusion among light nuclei is extremely small.

One possibility of achieving nuclear fusion is to raise the temperature to tens or even hundreds of millions of degrees. For this reason, the fusion reaction of light nuclei is also referred to as thermonuclear reaction.

In the past, thermonuclear reaction has taken place in explosion of hydrogen bombs. However, the explosion of a hydrogen bomb is not a controlled process.

Inside the hydrogen bomb, a small atomic bomb is detonated, creating extremely high temperature and pressure, which cause the hydrogen bomb to explode. In a split second, a huge amount of energy is completely released; thus it cannot be harnessed according to our needs in this process.

Therefore, controlled thermonuclear reaction has become one of the major topics of current scientific research.

It is known that under a high temperature of tens of hundreds of millions of degrees, atoms will be ionized into a plasma of electrons and nuclei. In order for the nuclei to participate fully in the fusion reaction, a high-density plasma must be confined in a limited space for a sufficiently long period. For example, if a high-density plasma at the temperature of 100 million degrees is confined for approximately one second, the energy produced will exceed the input energy, i.e., once "ignition" takes place, the thermonuclear reaction will be able to sustain itself.

Scientists have explored many different techniques to confine the ionized plasma. The most important techniques are magnetic confinement and inertial confinement. Magnetic confinement techniques include the "Tokamak", the magnetic mirror, and the stellator; the most promising inertial confinement technique is the laser-induced fusion, others include electron beam induced and heavy ion beam induced fusion.

Today, while controlled thermonuclear fusion is still far from becoming a reality, it is clearly getting closer to this goal.

In Greek mythology, it was said that the fire on earth was stolen from heaven by the brave Prometheus. But the real heavenly fire is no ordinary fire; it is the "fire" from the thermonuclear reactions that are continuously taking place on the sun and on other stars. This "fire" was first obtained by man on 1 November 1952 when the first hydrogen bomb was exploded, but so far we have not been able to control and exploit this energy source.

Scientists from many countries, including China, are devoting their efforts to harnessing this "heavenly fire."

#### A History of Struggles

Like the research efforts of controlled thermonuclear fusion in other countries, the development of "China Cyclotron No. 1" has not been all smooth-sailing; it had a history of struggles, which involved solving many difficult technical problems and took a total of 14 years.

At the end of 1970, the just-invented Soviet "Tokamak" came to the attention of Chinese scientists. Based on papers and pictures published in the literature, they began their own research work.

"Tokamak" is an experimental device for studying controlled thermonuclear fusion; its main component is a ring-shaped vacuum container with electric coils around it to form an annular magnetic field. Confined inside this

container, the plasma can only move in the direction of the magnetic lines, as in the case of a rotating top, without touching the container walls. This device is today's primary tool for studying controlled thermonuclear fusion.

In China, that was the period of the "ten-year chaos," when the gang of four was trying to destroy all scientific endeavors and eliminate the intellectuals. Each step of scientific progress was met with a great deal of resistance.

The goal was quite clear. It was to develop, based on China's industrial and technological capabilities, a "Tokamak" facility of similar scope and having similar technical performance as those of other countries, and representative of the development trend in order to promote China's controlled thermonuclear fusion research and development activities. This industrial "Tokamak" facility was named "China Cyclotron No. 1."

The outer ring of "China Cyclotron No. 1" has a radius of 102 cm, the plasma inner radius is 20 cm; the longitudinal magnetic field strength is 5 Tesla and the plasma current is 400 kilo-amps. The plasma temperature is estimated to reach 8 million degrees, and the energy confinement period is 40 milli-seconds. In terms of both scope and performance, it is comparable to the international standards of the early and mid-70's.

In order to ensure normal starting and normal operation of "China Cyclotron No. 1," it is necessary to have a powerful motor drive system, a generator and power supply system, an annular high vacuum chamber system, a control and measurement system, a test monitoring and diagnostic system as well as the ability to carry out large-scale construction projects.

A 75-ton iron-core ohm transformer must be fabricated. This special-purpose transformer is 6 m tall, 6.3 m wide, and can withstand voltage as high as 40,000 volts, and its central column must have a vertical tolerance of less than 1 part in 1,000.

In order to produce a magnetic field of 50,000 Gauss and a force of 5,000 tons to confine the plasma, it is required to have a 14,000 volt-amp pulse generator as the power supply.

The central element of this device, the cyclotron, is a high-technology mechanical and electromagnetic device; it must withstand a temperature of 450 degrees C, and must maintain a high vacuum of  $10^{-7}$  mm Hg inside the unit. It is made of eight independent pieces which are assembled using the gold-wire press and seal technique. The construction of its interior, the high-strength magnetic coils, and the sliding base are technologically very difficult tasks and must meet strict technical requirements.

Impurities in the plasma will result in energy loss. Therefore, a special hydrogen or deuterium supply system is required where the hydrogen or deuterium content must be purified to a level of 0.99999.

All these technical difficulties had been overcome one by one. "China Cyclotron No. 1" is currently China's largest "Tokamak" controlled thermonuclear

experimental facility. It is the joint product and fruit of labor of over 100 organizations, and of many scientists, engineers, technicians, and Party officials.

### A Bright Future

Today, a race is going on among different nations to pursue experimental research of controlled thermonuclear fusion.

At present, there are several hundred experimental facilities in the world for conducting controlled thermonuclear fusion research, which can be classified into dozens of different types. The current trend is to develop larger and larger reactors. In particular, "Tokamak" is considered to be the primary tool for conducting such experiments.

Many large-scale "Tokamak" reactors have been constructed, and encouraging results have been reported in the United States, the Soviet Union, Japan, and the European Coalition.

At the end of 1982, a three-story-high controlled thermonuclear experimental reactor, the world's largest, was built in the United States. The European Coalition is in the process of constructing a state-of-the-art international thermonuclear reactor in England which will occupy 15,000 m<sup>2</sup> of space and have a power of 500,000 kW.

It should be pointed out that controlled thermonuclear fusion is still in the stage of being tested for its "scientific feasibility." There are many difficult problems to be solved, but the future looks promising. The U.S. experimental reactor has already produced a plasma with temperatures as high as 70 million degrees and confinement period of 1/3 of a second, which is not far from the condition of "ignition." Scientists believe that by 1986, "ignition" can be achieved in a "Tokamak" type controlled thermonuclear reactor.

As to the question of actually harnessing the "heavenly fire," scientists believe that a "production and test" type controlled thermonuclear reactor can be built by the year 2000. However, the construction of thermonuclear power plants and large-scale industrial use of thermonuclear energy are not likely to happen until well into the 21st century.

China must also strive to march forward in this field, otherwise we will be falling farther behind the standards of the developed nations. The completion of "China Cyclotron No. 1" had reinforced our confidence and gave us the assurance that we have the ability to contribute toward the realization of controlled thermonuclear fusion, and toward the exploitation of the boundless thermonuclear energy.

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CSO: 4008/402

APPLIED SCIENCES

COMPUTER-AIDED DESIGN OF CAMS

Beijing DIANZI JISHU YINGYONG [APPLICATION OF ELECTRONIC TECHNIQUE] in Chinese  
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[Text] Cam is a mechanism which is widely used in automated machines, instruments, and various control devices; by properly designing the profile of the cam, it is possible to achieve any desired motion of moving parts. Therefore, the central problem of cam design is to determine the profile of the cam in accordance with the desired motion of a particular moving part.

Cam design can be carried out by either graphical or analytical method. Graphical method provides a simple means of plotting the profile, but because of the large plotting errors involved, it cannot meet the requirement of high-precision cams (e.g., cams used in computers, cam explorators, and high-speed cams). For such applications it is necessary to use analytical method to derive the equation of the cam profile, from which the coordinates of each point on the profile can be accurately calculated and plotted. However, to calculate the coordinates of the cam profile from the equation of motion of the moving parts is a very tedious task, which to some extent limits the practical application of the analytical method. With the development of computer technology and increasing use of digital control technology and photo-electric technology in machine processing, analytical method of cam design now has more practical value and is expected to be widely used in actual production.

By using the DTS-130 computer and the CTS-1 digital X-Y plotter, we have developed a BASIC program "CP-1" to design the profiles of disk cams with reciprocating type followers. The details of this program are introduced below.

### I. Derivation of the Parametric Equations of Cam Profile

The parametric equations of the cam profile can be expressed either in rectangular coordinates or in polar coordinates with the origin located at the center of rotation of the cam.

First, we shall derive the parametric equations in rectangular coordinates for the theoretical profile of a disk cam with a pointed reciprocating follower.

Figure 1 shows the motion diagram of a disk cam with a reciprocating offset follower, where B is an arbitrary point on the theoretical profile. In the rectangular coordinate system, the coordinates of B, i.e., the parametric equations of the theoretical profile are given by:

$$\left. \begin{aligned} x &= KC - KD = (S_0 + S) \cdot \cos J - E \cdot \sin J \\ y &= OD + CB = E \cdot \cos J + (S_0 + S) \cdot \sin J \end{aligned} \right\} \quad (1)$$

where  $x, y$  -- the coordinates of a point on the theoretical profile, in units of mm;

$E$  ----- offset distance of the follower, in units of mm;

$R$  ----- radius of the base circle of the cam, in units of mm;

$J$  ----- turning angle of the cam, in radians;

$$S_0 = \sqrt{R^2 - E^2}$$

$S = f(J)$  is the equation of motion of the follower which corresponds to different turn intervals of the cam.

The actual profile of a disk cam with a roller follower is the envelope of a family of roller circles whose centers are located on the theoretical profile. From the envelope equation one can derive the parametric equations of the actual profile in rectangular coordinates:

$$\left. \begin{aligned} x_1 &= x \pm R_0 \frac{dy/dJ}{\sqrt{(dx/dJ)^2 + (dy/dJ)^2}} \\ y_1 &= y \mp R_0 \frac{dx/dJ}{\sqrt{(dx/dJ)^2 + (dy/dJ)^2}} \end{aligned} \right\} \quad (2)$$

where  $x, y$  -- the coordinates of a point on the theoretical profile as determined by equation (1);

$x_1, y_1$  -- the coordinates of a point on the actual profile which correspond to the point  $(x, y)$ ;

$R_0$  ----- radius of the roller on the follower, in units of mm

$$\begin{aligned} \frac{dx}{dJ} &= \left( \frac{dS}{dJ} - E \right) \cdot \cos J - (S_0 + S) \cdot \sin J, \\ \frac{dy}{dJ} &= \left( \frac{dS}{dJ} - E \right) \cdot \sin J + (S_0 + S) \cdot \cos J, \end{aligned}$$

The source program for computer-aided cam design is based on the mathematical model given by equations (1) and (2).

## II. Program Block Diagram

On the basis of the specified conditions, the technical requirements of general cam design and the above parametric equations, the following block diagram of the computer program is obtained:

Figure 1.

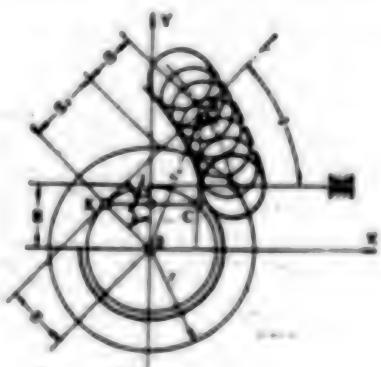
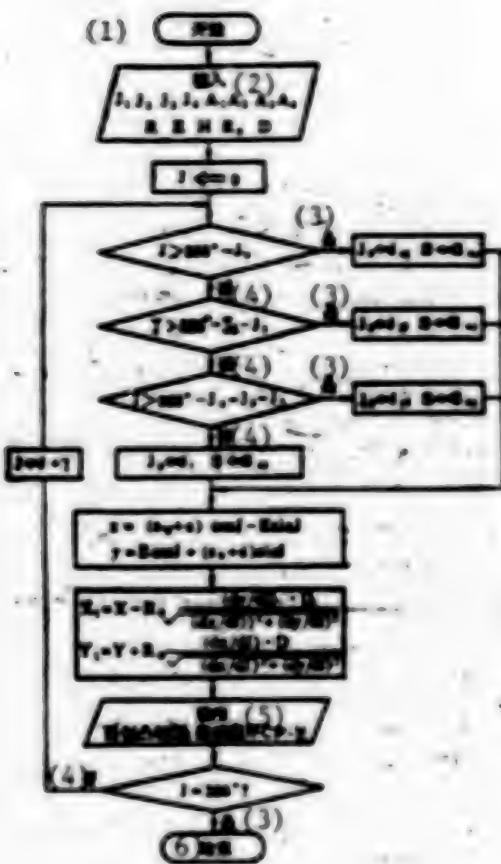


Figure 2.

Key:

1. start
2. input
3. yes
4. no
5. output to program CP-2 for plotting the cam profile
6. finish

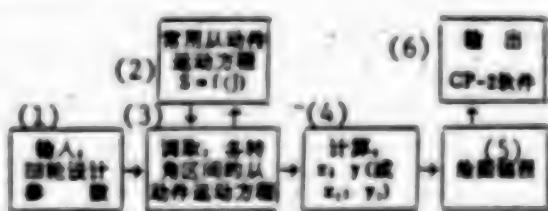


### III. Introduction to the CP-1 Source Program

It is clear from the computational procedure of Figure 2 that the CP-1 program consists of six modules as shown in Figure 3.

Figure 3.

Key:



1. input: cam design parameters
2. general equation of motion of the follower  $S = f(I)$
3. fetch: follower equation of motion for each turn interval
4. calculate:  $x, y$  (or  $x_1$  or  $y_1$ )
5. plotting program
6. output CP-2 software

### 1. Capability of the CP-1 Source Program

The main function of the CP-1 program is to generate a plotting program (CP-2) for plotting the theoretical and actual profiles of a disk cam based on the specified design parameters, and to generate plots of the designed cam profiles on the CTS-1 plotter.

The main applications of this program are to design the profiles of disk-shaped cams for which the number of turn intervals is less than four, and the follower obeys conventional laws of motion (i.e., uniform speed, constant acceleration or deceleration, cosinusoidal acceleration and sinusoidal acceleration).

By modifying a few statements of the program, it can also be used to design cam profile where the number of turn intervals is greater than four, or the law of motion of the follower is given by the expression  $S = f(J)$ .

## 2. Input of Cam Design Parameters

After the CP-1 source program is loaded into the computer, the first step is to input the following design parameters via the terminal:  $J_1, J_2, J_3, J_4; A_1, A_2, A_3, A_4; R; E; H; R_o; D$ .

The most common and typical motion type of the follower in a cam mechanism is the stop-rise-stop motion. Therefore, the CP-1 program allows the introduction of four turn intervals, denoted by  $J_1, J_2, J_3$  and  $J_4$ , measured in degrees.

$A_1, A_2, A_3, A_4$  are codes for the law of motion  $S = f(J)$  of the follower which correspond to the four turn intervals. The interpretation of the codes is explained in the following table.

Table of codes  $A_j$  for the equations of motion of the follower

Key:

1. rest-stop
2. forward stroke
3. return stroke
4. law of motion
5. near rest-stop
6. far rest-stop
7. uniform speed
8. constant acceleration and deceleration
9. cosinusoidal acceleration
10. sinusoidal acceleration

Ai	(1)			(2)			(3)				
	0	1	2	3	4	5	6	7	8	9	10
(4)	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0

The interpretation and units of  $R, E, R_o$  have been explained before;  $H$  denotes the maximum travel of the follower in units of mm;  $D$  is a parameter which represents either the inner or outer envelope. When  $D = 0$ , the theoretical cam profile is plotted; when  $D = 1$ , the inner envelope of the actual profile is plotted; when  $D = -1$  the outer envelope of the actual profile is plotted (as shown in Figure 4).

## 3. Output of the CP-1 Source Program

In the second part of the CP-1 source program, "conditional statements" are used to insert the appropriate subroutines of the plotting program (e.g., subroutine for circular arc, straight line segment) into the  $x_1$  and  $y_1$  data array generated by the CP-1 source program. In this manner, the output of the source

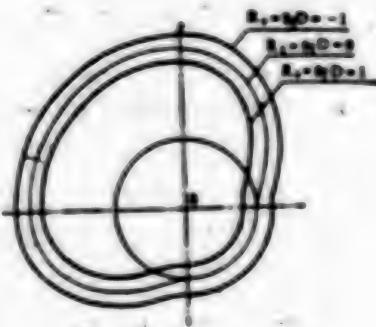
program becomes the CP-2 plotting program which can be used directly to plot the designed cam profile on the CTS-1 plotter.

If the "automated program" section used for plotting is replaced by subroutines used in digital control devices, then the output of this program becomes a piece of software which can be used to control the operation of a digitally-controlled lathe for processing the cams.

#### IV. Plotting the Cam Profile

First, an "interpreter program" used in the CTS-1 plotter is loaded into the computer, followed by the CP-2 plotting program. Now we are ready to plot the designed cam profile on the plotting board of the CTS-1 plotter according to the specified scale.

Figure 4.



#### V. Special Notes for Using the CP-1 Source Program

1. If the follower of the cam is designed to obey a specified law of motion, then after loading the CP-1 program, the function  $S = f(J)$  must be inserted in a location occupied by a conventional equation of motion which is not expected to be used in the cam design, and the corresponding code is used to represent the function  $S = f(J)$ . Subsequently, it is loaded into the computer along with the other design parameters (as shown in Figure 5).
2. If the motion of the follower is stop-rise-fall-stop, i.e., if the has three turn intervals, then the following input parameters should be assigned:  $J_1 = 0$ ,  $A_1 = 0$ . (as shown in Figure 6)
3. If the motion of the follower is rise-fall-rise, i.e., if the cam has only two turn intervals, the following design parameters should be assigned:  $J_1 = 0$ ,  $J_2 = 0$ ;  $A_1 = 0$ ,  $A_2 = 0$ . (as shown in Figure 5)
4. If only the theoretical profile is plotted, the following design parameters should be assigned:  $R_0 = 0$ ;  $D = 0$ .

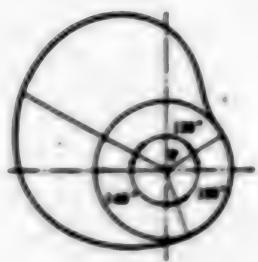
As a result of advancement in digital control technology and photo-electric technology, we have made significant progress in curve processing techniques. If we make additional efforts in computer usage and in standardizing the programming languages of digitally-controlled machine tools, we will be able to

use computers not only for cam design but also for direct control of the operation of digitally-controlled machine tools.

Figure 5.



Figure 6.



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APPLIED SCIENCES

DUAL-FREQUENCY LASER ENERGY CENTER TEST INSTRUMENTS

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[Text] I. Introduction

High-precision level measurement is the primary tool for studying vertical deformation of the earth crust. It can be used to study the fall of the earth surface, the measure dam deformation, and to measure the important parameters in earthquake prediction. But in the past, level measurements are generally performed by manual means, which are very slow, and have short front and back visual range; they are also tedious and have poor measurement accuracy and poor stability.

Laser provides a new dimension to high-precision level measurement because of its good monochromaticity, high energy concentration, and narrow beam. But a laser propagating through the atmosphere is subject to the following two adverse effects: one is the effect of absorption and scattering of the light wave by the atmosphere, resulting in the attenuation of laser energy, it is called atmospheric attenuation; the second effect is the atmospheric turbulence, which causes random fluctuations in the index of refraction, thereby creating fluctuations in the light wave parameters, causing beam drift, image jitter, and resulting in errors in the measurement. In order to eliminate the effect of atmospheric turbulence in high-precision measurement, the laser is often propagated through a vacuum conduit, which leads to additional complexity of the measurement system, and its application becomes very limited.

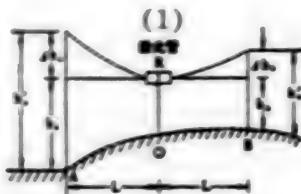
In order to overcome this difficulty, theoretical research and practical development of a dual-frequency laser system are being pursued both in China and abroad. A dual-frequency laser is a device which emits laser beams with two different wavelengths; it provides a means for eliminating and correcting the measurement errors caused by atmospheric turbulence. In this article, the basic principle of a dual-frequency measurement system is briefly described, and the designs of two practical measurement systems are discussed. In particular, the operation and circuit design of a dual-frequency laser energy-center test instrument developed by the authors are described in detail.

## II. Principle of Level Measurement Using Lasers

Figure 1. Schematic diagram of level measurement using laser

Key:

1. laser tube



The schematic diagram of a laser level measurement system is shown in Figure 1. The laser tube is positioned at a certain height (point R) above the point O. Let B be the reference point whose elevation above sea level is known, and A is the point to be measured. If the height of the horizontal beam emitted by the laser tube is measured at point A and point B respectively, then the difference in height between A and B can be readily obtained:  $h = h_a - h_b$  (of course, if the level height of the point O and the height OR are known, then the height difference between A, B and O can be measured).

If atmospheric effects are taken into account, then the position of the actual beam will be shifted, and the height difference readout becomes

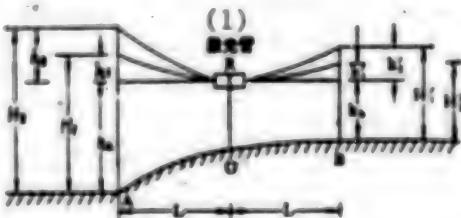
$$\begin{aligned}
 h' &= h_a' - h_b' \\
 &= (h_a + \Delta h_a) - (h_b + \Delta h_b) \\
 &= (h_a - h_b) + (\Delta h_a - \Delta h_b) \\
 &\neq h
 \end{aligned}$$

Therefore, atmospheric effects cause errors in the measurement. If a dual-frequency laser is used (Figure 2), then at wavelength  $\lambda_1$  the position of A is  $H_1 = h_a + h_1$ , and the position of B is  $H_1' = h_b + h_1'$ ; at wavelength  $\lambda_2$ , the positions of A and B are respectively  $H_2 = h_a + h_2$ ,  $H_2' = h_b + h_2'$ .

Figure 2. Schematic diagram of level measurement using dual-frequency laser

Key:

1. laser tube



Clearly, at the same observation point, the position deviation between the light spots of the two different wavelength laser beams is

$$\begin{aligned}
 \delta &= H_1 - H_1' \\
 &= h_1 - h_1'
 \end{aligned} \tag{1}$$

According to the theory of laser propagation, for two laser beams with specified wavelengths, the ratio  $h_2/h_1 = r$  is a constant<sup>[1]</sup>. By substituting this value into equation (1), we obtain:

$$\begin{aligned} h_2 &= \delta + h_1 & (2) \\ &= \delta + \frac{h_1}{r} \\ \therefore h_2 &= \frac{\delta r}{r-1} \end{aligned}$$

From equation (1)

$$\begin{aligned} h_1 &= h_2 - \delta \\ &= \frac{\delta}{r-1} \end{aligned} \quad (3)$$

In a similar manner,  $h'_2$  and  $h'_1$  can also be computed, i.e.,

$$\begin{aligned} h'_2 &= \frac{\delta' r}{r-1} \\ h'_1 &= \frac{\delta'}{r-1} \end{aligned}$$

where  $\delta'$  is the position deviation between the two different wavelength laser beams at the observation point B.

Therefore,

$$\begin{aligned} h_2 &= H_2 - h'_1 \\ &= H_2 - \frac{r}{r-1} \delta' \end{aligned} \quad (4)$$

$$\begin{aligned} h_1 &= H'_1 - h'_1 \\ &= H'_1 - \frac{r}{r-1} \delta' \end{aligned} \quad (5)$$

and the height difference is

$$h = h_2 - h'_1 \quad (6)$$

or 
$$h = (H_2 - H'_1) + \frac{r}{r-1} (\delta' - \delta) \quad (6')$$

On the basis of these results, we propose two different measurement procedures to eliminate the effects of atmospheric propagation.

### 1. Difference Value Procedure

By measuring the height of each of the measured points from one of the two laser beams,  $H_2$  (or  $H'_1$ ) and the deviation between the two beams  $\delta$  (or  $\delta'$ ), one can determine the actual height  $h_a$  (or  $h_b$ ) and the height difference  $h$ .

## 2. Zero Difference Value Procedure

If  $\delta = 0$ , then it follows from equations (1) and (4) that  $H_2 = H_1 = h_a$ . Similarly, when  $\delta' = 0$ , then  $H_2' = H_1' = h_b$ . In other words, when the deviation ( $\delta$  or  $\delta'$ ) between the beam spots for two different wavelengths is zero, then the readout position of the beam spot  $H_2$  (or  $H_2'$ ) should be the horizontal position of the laser beam  $h_a$  (or  $h_b$ ) with the atmospheric effects removed; from this the height difference  $h$  can be readily computed.

The above discussion shows that dual-frequency laser can eliminate the measurement errors caused by atmospheric effects, and therefore provides a new dimension in level measurement. The dual-frequency laser test instrument which we developed has also designed for the same purpose.

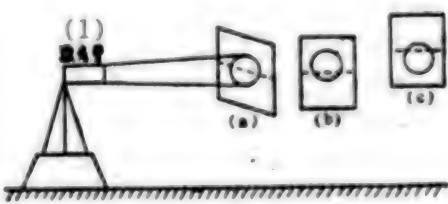
## III. Basic Principle of the Laser Energy Center Test Instrument

The laser spirit level is rigidly attached to the base rock marker, which is anchored to the base rock; thus, it can be regarded as a fixed level surface. The laser is emitted in a horizontal direction; the receiving target at the test point, which is a two-quadrant photo-electric sensing element, is installed on a vertical screw rod. By rotating the screw rod, the target can be moved up and down. If the laser beam is aligned with the center of the receiving element (Figure 3(a)), it means that the receiving element and the laser are on the same horizontal plane. If the earth surface has fallen, then the target position will shift downward (Figure 3(b)), and the light energy received by the upper part of the element will be greater than that of the lower part, thereby producing an unbalanced electric signal through the photo-electric conversion circuit. This signal will pass through a series of logic controls and the tracking system to cause the screw rod to rotate in a direction such that the target will move upward to reach a new equilibrium condition. Since the number of pulses used to control the motion during the tracking process is proportional to the vertical displacement of the receiving target, it can be recorded and converted into the amount of fall of the earth surface.

Figure 3. Schematic diagram of the relative position of the laser beam on the receiving target

Key:

1. laser tube



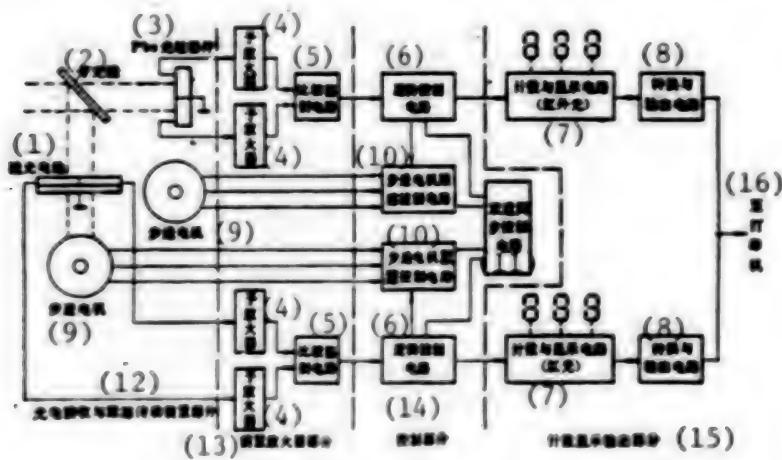
By the same token, if the earth surface rises, then the light energy received by the lower part of the target will be greater than that of the upper part, and tracking system will cause the screw rod to rotate in the opposite direction until a new equilibrium is reached. The number of pulses recorded by the digital counter indicates the amount of rise of the earth surface.

The dual-frequency laser energy-center test instrument was designed on the basis of the above principle.

#### IV. Principle and Design of the Dual-Frequency Energy-Center Test Instrument Circuits

The laser energy-center test instrument has four sections: 1) the photo-electric receiving pre-amplifier; 2) the tracking gear and control; 3) the digital counter, display, and recorder; and 4) the overall logic control. A block diagram of the overall logic of this instrument is shown in Figure 4.

Figure 4. Overall logic block diagram



##### Key:

1. silicon photo-cell	10. step motor tracking and control circuit
2. spectroscope	11. dual channel synchronous control circuit
3. PbS light-sensitive element	12. photo-electric receiver and tracking gear section
4. pre-amplifier	13. pre-amplifier section
5. discriminator circuit	14. control section
6. logic control circuit	15. digital counter and output display section
7. counter and display circuit (infrared light)	16. to printer
8. conversion and output circuit	
9. step motor	

##### (A) Photo-Electric Receiver and Pre-Amplifier Section

###### 1. Photo-electric receiving target

The main function of this section is to separate the red light and infrared light contained in the dual-frequency laser into two single-frequency laser beams, which are received by the two-quadrant photo-electric device, and converted into electric signals.

Here, we use a dual-frequency laser tube containing red light (wavelength 6328 Å) and infrared light (wavelength 1.13  $\mu\text{m}$ ) to produce a single dual-frequency laser beam, which is split into two by the spectroscope. The subtended angle between the infrared beam and the dual-frequency laser is  $0^\circ$  (i.e., the infrared beam through the spectroscope is projected directly onto the infrared receiving target), and the subtended angle between the red beam and the dual-frequency laser is  $90^\circ$  (i.e., the red beam is deflected  $90^\circ$  at the spectroscope).

The red-light receiving target is made of silicon photocell, the infrared receiving target is made of lead sulfide (PbS) light-sensitive element. Each target is controlled by a set of step motor driven tracking gear to move up and down so it can automatically track the center of the laser energy.

## 2. Pre-amplification circuit

### Preamplification Block Diagram

#### Key:

1. laser beam spot
2. photo-electric receiving element
3. pre-amplifier
4. comparator
5. discriminator

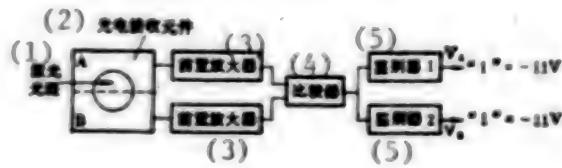


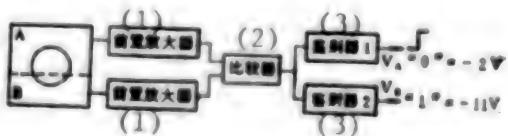
Figure 5 shows the block diagram of the pre-amplification circuit, where A, B are the upper and lower quadrants of the photo-electric element. When the laser beam is centered between A and B, the energy received by the two quadrants are equal, and the output signals from the preamplifiers are also equal. Therefore, the output of the comparator is zero, and the state of the discrimination circuit remains unchanged, with the outputs from both channels being "1" (or -11 v using negative logic).

When the laser beam is pointed downward (as shown in Figure 6), the amount of laser energy received by A is smaller than the energy received by B, thus the output electric signal from B is greater than that from A. Consequently, the two output signals reaching the comparator through the pre-amplifiers are not equal, and a negative voltage is generated. This causes the state of discriminator 2 to be flipped, and produces an output voltage of -2 v ("0" state). Discriminator 1 remains in its initial state.

Figure 6. Block diagram of the pre-amplifier section when the laser beam is pointed downward

#### Key:

1. pre-amplifier
2. comparator
3. discriminator (1 and 2)

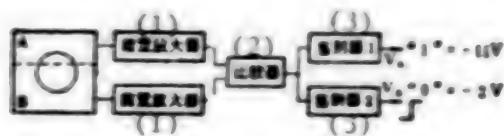


Conversely, when the laser beam is pointed upward, (Figure 7), the state of discriminator 2 remains unchanged at  $-11V$ , while the state of discriminator 1 is flipped to produce an output voltage of  $-2V$ .

Figure 7. Block diagram of the pre-amplifier section when the laser beam is pointed upward

Key:

1. pre-amplifier
2. comparator
3. discriminator (1 and 2)



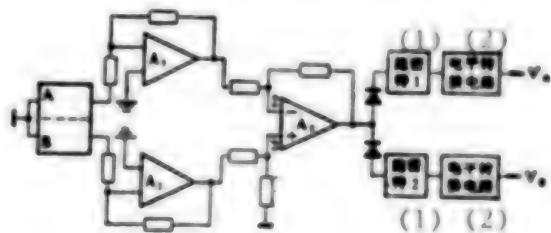
The red and infrared receiving elements are made of different materials which have different sensitivities to light. In order to achieve the same sensitivity for both channels, two different types of circuits are used in the pre-amplifier circuit.

The red-light pre-amplification circuit is shown in Figure 8, where  $A_1$ ,  $A_2$  are two dual-channel choppers. They use F.E.T. series-parallel modulators and single-tube linear integrated circuit for amplification. This avoids the problems of frequent failures of mechanical choppers and the unreliable and difficult task of choosing individual components.

Figure 8. Red-light pre-amplification circuit

Key:

1. Schmidt
2. voltage conversion circuit



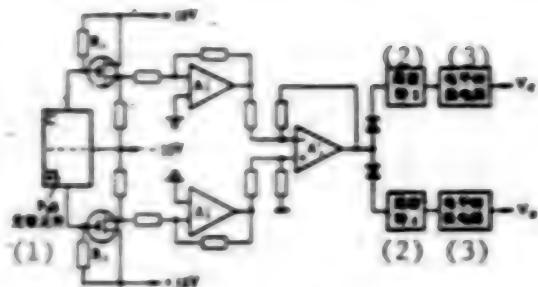
$A_3$  is a voltage comparator which uses the gain amplifier of the F004 (5G23). The two output signals from the pre-amplifiers are sent to the input terminals "2" and "3" of the comparator. When the signal at "2" is smaller than the signal at "3," the comparator output is positive (the current through element A is larger); conversely (when the current through element B is larger), the comparator output is negative. If the signals at "2" and "3" are equal, the comparator output is zero.

The discriminator circuit is composed of a Schmidt circuit and a level conversion circuit. When the comparator output is positive, Schmidt 1 is triggered, when the comparator output is negative, Schmidt 2 is triggered. Because of the different polarities of the two input signals to the Schmidt circuits, NPN type and PNP type transistors are used for each case. In order to make the output levels compatible with those of the PMOS circuits, two different types of level conversion circuits are used for the output of the two Schmidt circuits.

Figure 9. Infrared-light pre-amplification circuit

Key:

1. light-sensitive element
2. Schmidt
3. level conversion circuit



The infrared pre-amplifier circuit is shown in Figure 9. The resistance of the PbS light-sensitive element changes under the illumination of infrared light. To convert this change in resistance into variations in voltage, the +10v and -10v power sources are passed through the matched resistors  $R_1$ ,  $R_2$  and split at the points C and D of the PbS element to provide two output signals. Because of the large resistance of the PbS element ( $\sim$  several hundred  $\text{k}\Omega$ ), an F.E.T. follower is added before the pre-amplifier to achieve resistance matching. Also, to achieve better symmetry and temperature stability between the upper and lower transistors, 3DJ5H-C symmetrical tubes [dui guan 1417 4619] are used.

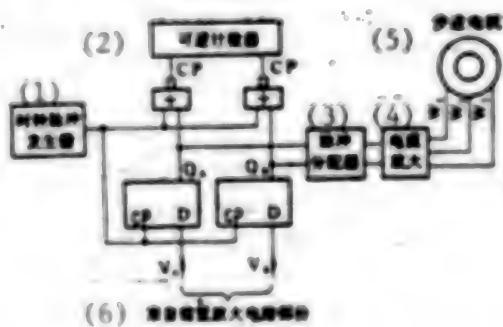
The pre-amplifiers  $A'_1$  and  $A'_2$  are also F004 integrated operation amplifiers; the amplification factor must be carefully adjusted to provide approximately the same sensitivity for the red and infrared channels. The comparator and discriminator circuits are identical for the infrared and red channels.

#### (B) Tracking Gear Section

Figure 10. Circuit diagram of the tracking gear section

Key:

1. time pulse generator
2. reversible digital counter
3. pulse distributor
4. current amplifier
5. step motor
6. from pre-amplifier circuit



The imbalance in laser energy creates unequal output voltages from the pre-amplifier circuit; to restore energy equilibrium between the upper and lower quadrants of the receiving element, the receiving target must be moved up or down in the appropriate direction. The movement of receiving target is accomplished by rotating the screw rod, which is driven by a step motor. Therefore, in order to track the center of the laser energy, it is necessary to have a tracking gear system whose circuit diagram is shown in Figure 10. The output voltages from the pre-amplifier circuit  $V_A$ ,  $V_B$  are first synchronized with

time pulse through two D trigger units. The output from the D trigger units are sent to the pulse distributor and current amplifier to form three-channel step signals  $W_1$ ,  $W_2$ ,  $W_3$ . The phase sequence of  $W_1$ ,  $W_2$ ,  $W_3$  changes according to whether the states of  $Q_A$ ,  $Q_B$  are "1," "0" or "0," "1"; it then controls the direction of rotation of the step motor to move the receiving target upward or downward. When the receiving target is aligned with the center of laser energy,  $V_A = V_B = -11v$ , and  $Q_A = Q_B = -11v$ , then the step motor rotation stops.

### (C) Digital Counter and Display Section

The main function of the digital counter and display section is to record and display the pulse number during step motor rotation. This number can be converted to the height difference between the current spot position and its initial position, which in turn provides data on the vertical shift of the earth surface. Specifically, the height change of the earth surface is  $d = k N$ , where  $k$  is the conversion factor between the step motor pulse number and the motion of the screw rod;  $N$  is the pulse number readout from the digital counter.

This instrument has two counters. One is a red-light counter, which directly records the pulse number given by the silicon cell while tracking the center of laser energy. The other is a differential counter, which records the position differences  $\Delta$  between the red and infrared beams on the receiving target; if  $d_1$  is the position difference between the red beam and the original equilibrium point,  $d_2$  is the deviation of the infrared beam, then

$$\Delta = d_1 - d_2 \quad (1)$$

Clearly, when the red beam position is higher than the infrared beam position,  $\Delta$  is positive; when the red beam position is lower than the infrared beam position,  $\Delta$  is negative. In order to accommodate both positive and negative numbers, a PMOS reversible counter is used. When  $\Delta = 0$ , the counter is preset to a value of 500 (3-digit display). Similarly, the red-light counter is also a reversible counter which will indicate the upward or downward red light deflection, or the fall or rise of the earth surface. At its initial equilibrium position, the counter is preset to 5000 (4-digit display). In the following paragraphs a more detailed description of the differential counter is presented.

Figure 11 shows the relative positions of the red light and infrared light on the receiving target. Table 1 lists the corresponding requirement of the logic states of the electric circuit.

In the states (a), (d) and (g), the red-light target center position (T) is aligned with the red beam center, and the infrared target center position (UT) is aligned with the infrared beam center; in these cases, both the red-light and differential counters indicate zero output.

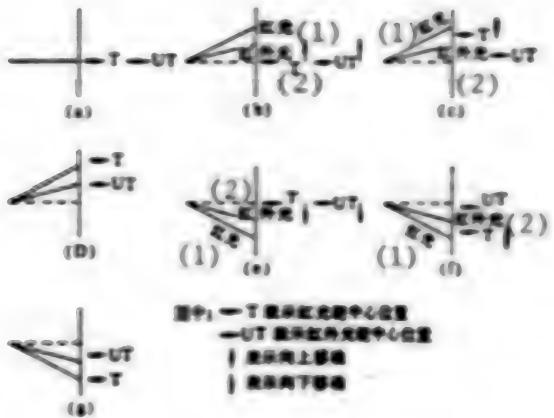
In state (b), the red beam and infrared beam are above T and UT respectively, thus both T and UT begin to move upward. Since both the red and infrared channels are synchronized to the same time pulse, the red-light counter should register a positive count ( $CP_+ = 1$ ;  $CP_{\Delta+} = 1$ ).

Figure 11. Relative positions of the red and infrared beams on the receiving target

Key:

1. red beam
2. infrared beam

Note: T is the position of the red target center  
 UT is the position of the infrared target center  
 — denotes upward motion  
 | denotes downward motion



AB	(4)				(5)							
	红(2)光	红(3)光	红光计数	差值计数	上V <sub>A</sub>	下V <sub>B</sub>	上V <sub>C</sub>	下V <sub>D</sub>	CP <sub>+</sub>	CP <sub>-</sub>	CP <sub>A</sub>	CP <sub>B</sub>
a, d, g	1	1	1	1	0	0	0	0				
b	0	1	-1	1	1	0	0	0				
c	0	1	1	1	1	0	1	0				
e	1	0	1	0	0	1	0	0				
f	1	0	1	1	0	1	0	1				
(6)注*	“1”表示-11V “0”表示-2V	(7)	“1”表示计数 “0”表示不计数	(8)								

Table 1

Key:

1. state
2. red light
3. infrared light
4. red-light counter
5. differential counter
6. "note"
7. "1" denotes -11V; "0" denotes -2V
8. "1" denotes counter output, "0" denotes no counter output

The states (e), (f) are opposite to the states (b), (c); each counter will indicate a negative count.

In summary, the counting pulse transmitted from the red-light counter to CP<sub>+</sub> and CP<sub>-</sub> can be controlled by signals in the A and B channels (A, B are the synchronized output from V<sub>A</sub>, V<sub>B</sub>, see Figure 15). The logic diagram is shown in Figure 12.

Figure 12. Control diagram of red-light counting pulse

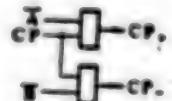


Table 2(a) CP<sub>A</sub>.

AB	CP <sub>A</sub>			
	00	01	11	10
00				
01		0		
11	0	1	0	0
10	0	0		0

Table 2(b) CP<sub>B</sub>.

AB	CP <sub>B</sub>			
	00	01	11	10
00				
01	0	0		0
11	0	1	0	1
10				0

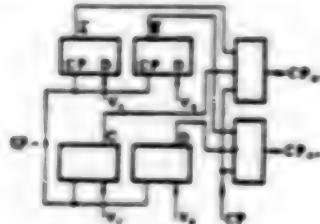
The control logic of  $CP_+$  and  $CP_-$  can be simplified by using the Carnot diagram (Table 2) as follows:

$$CP_+ = \bar{A}C \cdot CP$$

$$CP_- = \bar{B}D \cdot CP$$

From the above logic expressions, one can construct the logic diagram shown in Figure 13.

Figure 13. Control diagram of differential counting pulse



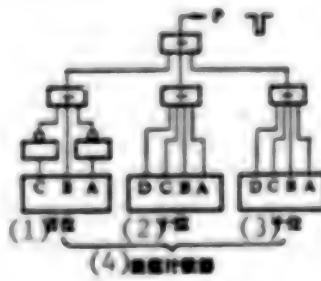
Based on the relative red-light position  $d_1$  measured by the counting circuit and the position deviation between the red light and infra-red light, one can readily compute  $h_a$  from equation (4); by a similar procedure, one can also obtain  $h_b$  and hence calculate the height difference  $h$  from equation (6). In addition, this instrument also has an operating mode to use the zero-difference value procedure for computing the height difference; the corresponding control circuit is shown in Figure 14.

When the differential counter readout is 500, a negative pulse is sent from the terminal P, which can be used as a signal for the printer to print out and red-light readout which corresponds to the case where atmospheric effects have been removed.

Figure 14. Zero-difference value control circuit

Key:

1. hundred-bit
2. ten-bit
3. unit-bit
4. differential counter



#### (D) Overall Control Logic Circuit

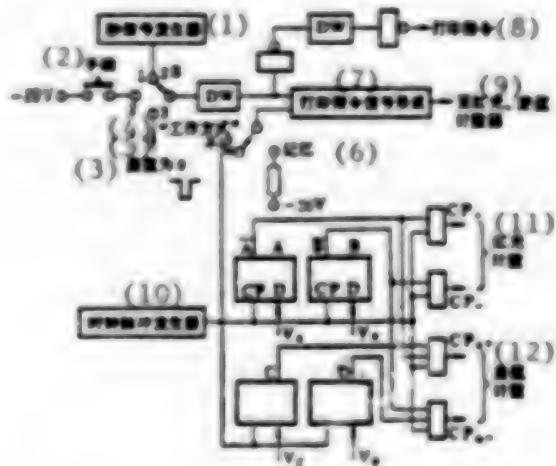
The overall control logic circuit is shown in Figure 15. It performs the following functions:

1. Based on the selection of the "operating mode" switch, a command signal is sent to the printer to print once every 2 seconds (position 1) during operation, to print manually (position 2), or to print automatically (position 3) in the zero difference value mode.
2. The instrument has a memory mode and a no-memory mode, which allow the digital display unit to show the counting process or show a memory state.
3. It forms the counting pulse control signals for the red-light counter and the differential counter.
4. It forms the pulse signal for the counter and the timing signal for the step motor.

Figure 15. Overall control logic block diagram

Key:

1. second signal generator
2. manual switch
3. difference value equal to zero
4. "operating mode"
5. no memory
6. with memory
7. formation of printer command signal
8. print command
9. to red-light and differential counters
10. timing pulse generator
11. red-light counter
12. differential counter



All component circuits are PMOS integrated gating circuits.

#### (E) Overall Performance Index

This instrument is capable of measuring the energy center of the red light ( $6328 \text{ \AA}$ ) and infrared light ( $1.15 \mu\text{m}$ ) of a dual-frequency, single-beam laser and the difference between the two beams at the observation point; it can automatically track the beam center, and display on a digital screen or print out the measured results.

Resolution: 0.03 mm for both red and infrared light

Accuracy: 0.09 mm for both red and infrared light

Beam tracking speed: 0.1 mm/sec (can be adjusted to 1 mm/sec if necessary)

The relationship between the digital display and the actual vertical displacement will be explained below.

The instrument uses the 45BF3 step motor with a step size of 1.5; thus, the number of pulses required for one complete turn is  $M = 360^\circ/1.5^\circ = 240$ . The screw rod driven by the step motor has a pitch  $D = 4 \text{ mm}$ , and the gear ratio is  $k_1 = 1:1$ ; therefore, for each pulse recorded by the digital counter, the receiving target will travel a distance  $d_0$  given by

$$d_0 = \frac{D}{M} \cdot \frac{1}{k_1} = \frac{4 \text{ mm}}{240} \cdot 1 = 0.0167 \text{ mm}$$

The relationship between the recorded pulse number  $N$  and the displacement  $d$  is

$$d = kN = 4N = 0.0167N \text{ mm}$$

If the receiving target travels 0.1 mm, the pulse number is 6; if the receiving target travels 1 mm, the pulse number is 60.

The difference between the pulse number from the digital display and 5000 (red light) or 500 represents the vertical deformation of the earth surface.

The results of equations (4), (5) and (6) were obtained under ideal conditions. If the effects of atmospheric turbulence, random fluctuations, and non-rigid fixtures are taken into consideration, the situation will be much more complicated. In practice, most measurements are taken automatically and a large amount of data are recorded (including both difference value and zero difference value procedures); the data are then corrected and statistical averages are computed to minimize the effect of atmospheric turbulence on the measurements.

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3012  
CSO: 4008/1031

APPLIED SCIENCES

LINEAR EXPANSION OF POLYURETHANE FOAM AT LOW TEMPERATURE

Beijing YUHANG XUEBAO [JOURNAL OF THE CHINESE SOCIETY OF ASTRONAUTICS] in Chinese No 4, 31 Oct 84 pp 98-103

[Article by Zhu Xian [2612 6343], Ji Yongfu [0370 0516 1133], Zhang Jianke [1728 1696 0668], Bai Pingxian [4101 0756 6343], and Han Yuanzhou [7281 3293 3166]: "Linear Expansion of Polyurethane Foam at Low Temperature"]

[Text] Text of English abstract: The effects of linear expansion of polyurethane foam on thermal insulation at low temperature have been analyzed. The laws of linear expansion of polyurethane foam at low temperature varying with temperature, density, directions and times of heat cycle have been studied and determined, and their mechanism has been researched. Based on a lot of experiments, the change range and average value of the linear expansion of polyurethane at low temperature have been given.

I. Introduction

Polyurethane foam is a new thermal insulating material which is light in weight, has high strength to weight ratio and at the same time has a low low temperature thermal conductance rate. In terms of performance in resisting impact and vibration, high reliability, and in weight and price it is superior to vacuum thermal insulation methods and thus although its effective thermal conduction rate is higher than the vacuum thermal insulation method, it is becoming increasingly used in situations which are large scale or in which the working environment is very harsh, especially in large-scale liquified natural gas storage tanks and hydroxide rocket motor liquid hydrogen and liquid oxygen storage containers. Generally speaking, the low temperature thermal insulation effects of foam frequently are complex functions of many factors, and identifying the relationship of these functions through experimental research and theoretical analysis, has important significance for quality control and improving industrial directions for producing chemicals. In [2] we have already given the irrelations of constant parameters of polyurethane foam low temperature thermal conductivity and density, closed pore rate and storage time. This paper presents the results of research on its low temperature linear expansion.

Linear expansion is one of the most important factors influences low temperature thermal effectiveness. This can be seen clearly from the following analysis: a foam thermal insulation layer was used for low temperature was glued to an

aluminum alloy container. When liquid hydrogen was first injected, the aluminum alloy first cooled then shrunk. Because of its influence, a compression stress was produced in the foam thermal insulation layer which could not cool in time. With the passage of time, the thermal insulation layer also cooled from the inside out and the foam cooled according to its own temperature and linear expansion coefficient. Since the linear expansion coefficient of the aluminum alloy was smaller than that of the foam, and at the same time its rigidity was far greater than the foam, this made the foam next to the container unable to cool completely because of the restriction of the aluminum plate, and finally, the difference of the linear coefficients between the foam and the aluminum alloy container and the unevenness of the foam layer's temperature produced a great pulling stress inside the foam layer next to the container and at the same time, the temperature within the surface layer of the foam which was about the same as room temperature, compression stress was also produced. Clearly, these stresses increased as the low temperature linear expansion coefficient of the foam increased. This frequently leads to splitting of the foam which destroys the thermal insulation layer and when designing low temperature storage containers, this factor must be fully considered.

There are two methods of describing linear expansion: one is to give the relative compression of room temperature  $L_{293} - L_T / L_{293}$ , called the linear expansion and recorded as  $\beta = L_{293} - L_T / L_{293}$ ; the other is to give the thermal change rate of linear expansion  $\frac{dL}{dT} = \frac{1}{L} \frac{dL}{dT}$ , recorded as  $\alpha$ , and called the linear expansion coefficient. Those of these methods are used in this paper.

## II. Experimental Research on Low Temperature Linear Expansion of Polyurethane Foam

Through dozens of detailed experimental measurements, we have studied the relationship of polyurethane foam low temperature linear expansion and foam growth direction; relationship with temperature; the relationship with foam density and the relationship under a series of cold and hot cycles. These are described below.

### I. Relationship of Low Temperature Linear Expansion and Foam Growth Direction

Since the parallel and perpendicular directions of growth of the pores are subjected to different internal and external forces in the foaming process, the foam's pores are elongated in the direction of growth. This creates directional differences in the thermo-physical and dynamic performance of the foam. Thus for each type of foam, samples are taken from two directions. Experiments arrived at the following conclusions: (1) generally speaking, low temperature linear expansion of samples perpendicular to the direction of growth is greater than samples parallel to the direction of growth. At  $\rho > 30 \text{ kg/m}^3$  density, when the linear expansion ratio  $(L_A / L_{11})_{20K} = 0.9 \pm 2$  of the two directions of growth in sprayed polyurethane foam at the temperature of liquid hydrogen and the linear expansion ratio  $(L_A / L_{11})_{20K} = 0.9 \pm 2.3$  of the two directions of growth in poured polyurethane foam (Jumiji 15112 5721 1015)) at the temperature of liquid hydrogen are averaged, the sprayed type  $(L_A / L_{11})_{20K} = 1.4$ , and the poured type  $(L_A / L_{11}) = 1.5$ .

2. The ratio  $R$  of low temperature linear expansion in the two directions is related to foam density. Figure 1 presents the results of a group of experiments on jumiji polyurethane foam. It can be seen that at foam density  $\rho > 30 \text{ kg/m}^3$ , the ratio  $R$  fluctuates around the average value  $R_0$ , but when  $\rho > 30 \text{ kg/m}^3$ , the ratio  $R$  rises sharply with the decline of the density  $\rho$ .

3. We discovered that the ratio of low temperature linear expansion in two directions in poured polyurethane foam is abnormal, being  $(\beta_1 / \beta_{11})_{\text{LN}2}$ . We microphotographed slices of these abnormal samples and discovered the differences with the normal case (Figure 2). The pores parallel to the direction of growth in these abnormal samples were not yet clearly elongated, but were even slightly shorter than the perpendicular direction (Figure 3).

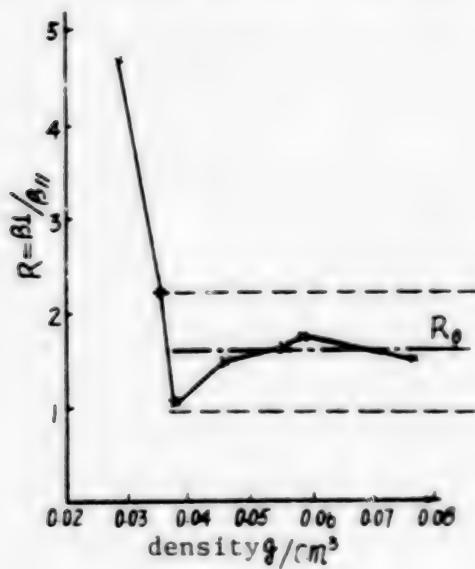


Figure 1. Relationship of density and linear expansion in two directions

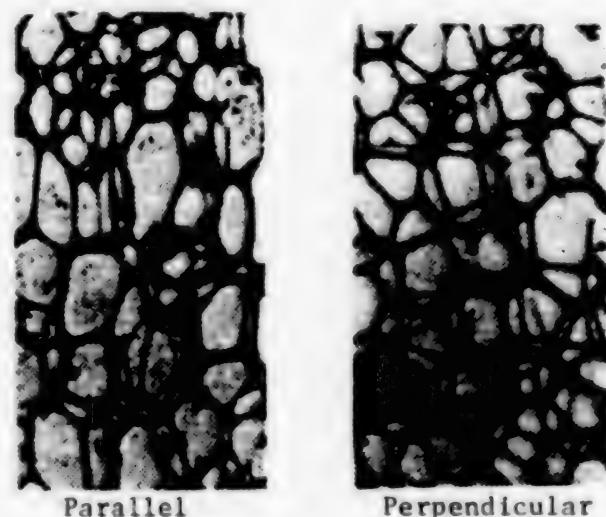
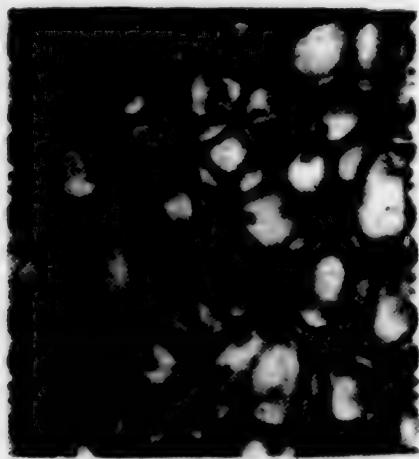


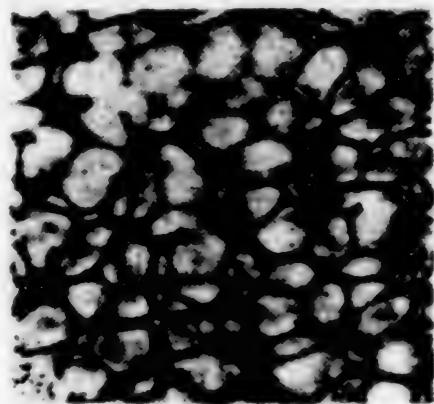
Figure 2. Microphotograph of two directions under normal conditions

This shows that indeed as D.J. Doherty et al. [1] pointed out, for poured foaming within a narrow opening mould, the direction of growth usually exhibits the eddying flow illustrated in Figure 4, and samples with parallel and perpendicular foaming direction can only be obtained from the foam within the dotted line area, when the other areas are sampled, the direction of growth obtained and the actual direction of growth both deviate to different degrees and the direction effect is not uniformly introduced in this sampling part and this is one of the big causes of dispersion between performance data of related foam, and thus one can assume that after limiting it to samples within the dotted line area, the abnormal  $R$  phenomenon will not appear again, and at the same time the magnitude of the fluctuations of  $R$  in Figure 1 will greatly diminish. On the other hand, because it is difficult to find pure parallel direction and perpendicular direction in many foams, then clearly the linear expansion will be between the two. Microphotographs reveal that the pores of polyurethane

foam exhibit polyhedron structure, leading us to understand the differences in various directions of its linear expansion thus: macroscopic linear expansion of foam in one direction, microscopically, is a repeated projection of the change in the length of the pore wall in that direction, but since these pore walls are not in a state where they can extend freely but are mutually bound together, the linear expansion of the pore walls will simultaneously give rise to extrusion or elongation causing the foam to deform. The precise mathematical model will be very complex but we suggest that interested comrades give it a try.



Parallel direction



Perpendicular direction

Figure 3. Microphotograph of two directions under abnormal conditions

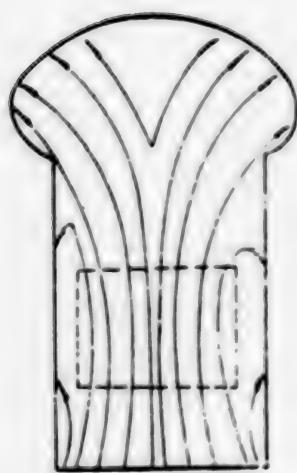
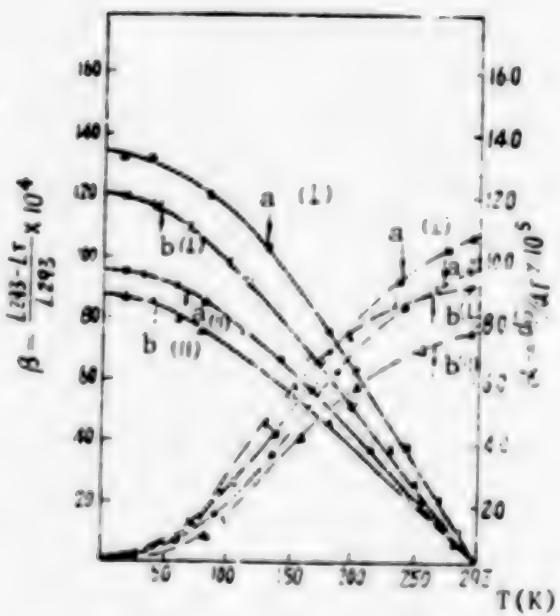


Figure 4. Growth of different parts of foam

Figure 5. →

Relationship of linear expansion coefficient  $\alpha$  and low temperature linear expansion  $\beta$  of polyurethane foam



- a. sprayed
- b. poured

## 2. Relationship of Low Temperature Linear Expansion and Temperature

To examine the interrelations of polyurethane foam low temperature linear expansion and temperature, we measured the low temperature linear expansion of several dozen samples from room temperature to the temperature of liquid hydrogen. Figure 5 gives the average values of the linear expansion of foams at a density greater than  $30 \text{ kg/m}^3$  and the coefficients of linear expansion. Generally speaking, for different kinds of foams in which  $\rho > 30 \text{ kg/m}^3$ , the range of change of linear expansion from room temperature to the temperature of liquid nitrogen were: sprayed foaming: perpendicular direction  $\beta_{\perp} = \frac{L_{293}-L_{77}}{L_{293}} \times 10^4 = 140 \sim 100$ ; parallel direction  $\beta_{11} = \frac{L_{293}-L_{77}}{L_{293}} \times 10^4 = 130 \sim 85$ ; poured foaming: perpendicular direction  $\beta_{\perp} = \frac{L_{293}-L_{77}}{L_{293}} \times 10^4 = 150 \sim 100$ ; parallel direction  $\beta_{11} = \frac{L_{293}-L_{77}}{L_{293}} \times 10^4 = 140 \sim 95$ . From the above data, it can be seen that the changes in low temperature linear expansion of various kinds of foam is very great and is related to such factors as the samples' density, components, foaming technology and sampling area. Nevertheless, the interrelation of the low temperature linear expansion coefficient  $\alpha$  of various kinds of polyurethane foam and temperature is very similar, both are very great at room temperature and at low temperatures, the value of  $\alpha$  drops rapidly with a drop in temperature, thus the integral  $\int_{20}^{293} \alpha dT$  is mainly determined by the  $\alpha$  value at room temperature, and the contribution of low temperature  $\alpha$  is very small, considering the overall change in length going from room temperature to the temperature of liquid hydrogen  $\Delta L = L_{293} \int_{20}^{293} \alpha dT$ . Thus, the linear expansion coefficient  $\alpha$  of foam at room temperature is a very good qualitative sign of the overall change in length going from room temperature to the temperature of liquid hydrogen. Quantitatively speaking, the difference measured in the linear expansion of the polyurethane foams at the temperature of liquid hydrogen and the temperature of liquid nitrogen and the ratio of the linear expansion at the temperature of liquid nitrogen were smaller than 10 percent. Averaging it out we get  $\beta_{20} - \beta_{77}/\beta_{77} = 7.6$  percent. This means that the cooling from the temperature of liquid nitrogen to the temperature of liquid hydrogen is less than one-tenth the cooling from room temperature to the temperature of liquid nitrogen, thus the major part of contraction when cooling takes place in the process of going from room temperature to the temperature of liquid nitrogen, thus, the thermal stress can be estimated using the linear expansion data for the temperature of liquid nitrogen according to the above proportions and need not use the experimental values of linear expansion of the temperature of liquid hydrogen.

## 3. The Interrelation of Low Temperature Linear Expansion and Foam Density

The low temperature linear expansion of two groups of polyurethane foam from room temperature to the temperature of liquid nitrogen was measured. Within each group there were 7 foams of increasing density, the density of the first group was from  $25 \text{ kg/m}^3$  to  $61 \text{ kg/m}^3$ , and the second group was from  $28 \text{ kg/m}^3$  to  $78 \text{ kg/m}^3$ , both groups were jumiji poured foam with freon-11 as the inflating agent. Figures 6a and 6b give the relationship between the density and the parallel and perpendicular direction of growth of low temperature linear

expansion of foam due to direction, in the perpendicular direction of growth there is a critical density  $\rho = 30\text{kg/m}^3$ , and when  $\rho > \rho_c$ , the linear expansion of foams of different densities fluctuates around a certain equilibrium, but when  $\rho < \rho_c$ , as  $\rho$  declines, the low temperature linear expansion rises sharply. In the parallel direction, the situations are strikingly different and can be divided into three regions: (1)  $\rho > 55\text{kg/m}^3$ , low temperature linear expansion of the foam slowly rises as  $\rho$  rises; (2)  $55\text{kg/m}^3 > \rho > 40\text{kg/m}^3$ , linear expansion rises as  $\rho$  declines, with a peak at  $\rho = 40\text{kg/m}^3$ ; (3)  $\rho < 40\text{kg/m}^3$ , linear expansion declines as  $\rho$  declines.

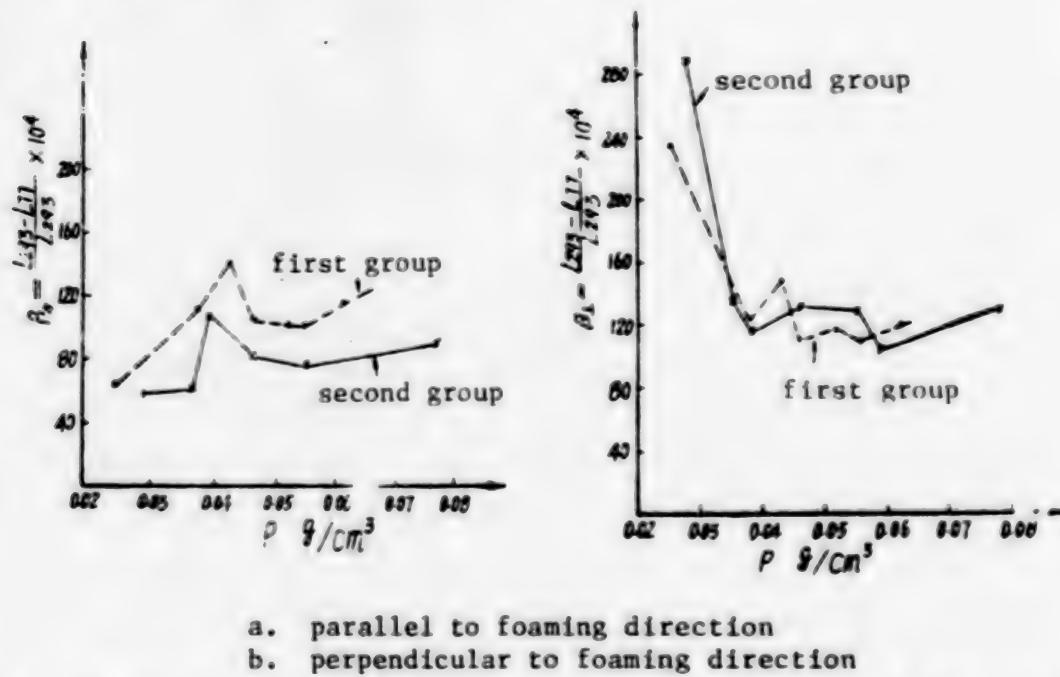


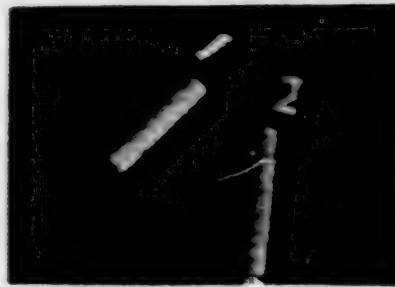
Figure 6. Relationship of low temperature linear expansion of foam and density

#### 4. Relationship of Low Temperature Linear Expansion and Environmental Temperature

In low temperature linear expansion testing, we have discovered by chance that several linear expansion samples of the same section and same direction of the same foam material which we could not finish measuring in the same day, when measured on a rainy day there were increases in linear expansion. This could be that low temperature linear expansion of foam is related to humidity. To verify this phenomenon, we placed a group of test samples of different densities at the mouth of a steam kettle to wet them with vapor and by measuring the linear expansion of the foam before and after steaming we clarified the influence of humidity. As a result we discovered that in the dampening process the mass of low density foam clearly expanded. Figure 7 illustrates that after 2 hours in steam, the mass of a foam sample of density  $\rho = 25\text{kg/m}^3$  expanded by 60 percent, the marks 1 and 2 indicate before and after steaming. The strange thing is that after the foam was removed from the steam and restored to room temperature, its mass did not return to its original value. Thus, this is a new phenomenon separate from thermal expansion. This phenomenon of rapid and

permanent expansion of mass in steam is extremely sensitive to foam density and as density increases, the speed diminishes.

Figure 7. Effect of steaming on low density foam



### III. Conclusion

Summarizing the above, the low temperature linear expansion of polyurethane foam reflects many complex interdependent relationship and thus the measurement results are of necessity rather scattered and in fact it is difficult to draw an authoritative linear expansion curve. Proceeding from the goal of thermal design, this article here gives a great deal of experimental statistical laws including general trends, the range of changes in low temperature linear expansion and their average values, as follows:

1. The general trend is for the low temperature linear expansion perpendicular to the direction of growth to be greater than parallel direction of growth, and averaging when density  $\rho > 30 \text{ kg/m}^3$ , the ratio of linear expansion under liquid hydrogen in the two directions of growth of the polyurethane foam (jumiji) we measured, whether sprayed foaming or poured,  $\beta_1/\beta_{11}$  was close to 1.4~1.5. Since parallel direction has the two advantages of less linear expansion and higher density, from the angle of linear expansion, in use, it should be more rational to glue it in the parallel direction to aluminum alloy containers.
2. In the perpendicular direction, there is a critical density  $\rho_c = 30 \text{ kg/m}^3$ . When  $\rho > \rho_c$ , there is basically no relationship between the low temperature linear expansion of polyurethane foam and density. When  $\rho > \rho_c$ , low temperature linear expansion rises sharply as  $\rho$  declines. In the parallel direction, it can be divided into three areas: when  $\rho > 55 \text{ kg/m}^3$ , low temperature linear expansion rises slowly as  $\rho$  rises; when  $55 \text{ kg/m}^3 > \rho > 40 \text{ kg/m}^3$ , linear expansion rises as  $\rho$  declines, with a peak at  $\rho = 40 \text{ kg/m}^3$ ; when  $\rho < 40 \text{ kg/m}^3$ , linear expansion declines as  $\rho$  declines. Based on the measurements in this paper, the average values and the range of change in the low temperature linear expansion of  $\rho > 30 \text{ kg/m}^3$  foam are illustrated in Figure 5. Because under many conditions it is difficult to find in foam pure parallel direction and perpendicular direction, linear expansion frequently falls in between the recommended values of the two directions.
3. In hot water and steam environments, the mass of low density foam permanent deformation far greater than thermal expansion occurs. Compared with  $\rho > 30 \text{ kg/m}^3$  foam, low density  $\rho > 30 \text{ kg/m}^3$  foam has higher heat conductivity<sup>[2]</sup>; low strength<sup>[3]</sup>; sharply increasing low temperature thermal expansion in the perpendicular direction; and enormous permanent deformation in hot water and steam environments. Thus, we naturally reach the conclusion that under no circumstances should  $\rho < \text{kg/m}^3$  foam be used for low temperature thermal insulation.

4. The low temperature thermal expansion coefficient  $\alpha$  of various kinds of polyurethane foam is a positive function of temperature, and it declines very quickly as the temperature declines. About 90 percent of the cooling from room temperature to the temperature of liquid hydrogen take place in going from room temperature to the temperature of liquid nitrogen.

Comrades Wang Hongkui [3769 7703 1145] and Huang Qian [7806 3383] provided the test samples and we thank them here especially.

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CSO: 4008/382

## SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

### ROLE OF JIN ZHAOXUN IN AIR FORCE RESEARCH WORK

Beijing BEIJING KEJI BAO in Chinese 30 Jul 84 p 1

[Article: "A Man Who Dares To Struggle for National Defense Scientific Research --A Record of the Deeds of Deputy Chief Engineer Jin Zhaoxun ]6855 0340 1852] of an Air Force Research Institute"]

[Excerpts] On 16 February 1984, CPC Central Committee Politburo member and Air Force Commander Zhang Tingfa [1728 1694 4099] and Air Force Political Commissar Gao Houliang [7559 0624 5328] issued a general order stating that Deputy Chief Engineer Jin Zhaoxun of a certain Air Force research institute had made prominent achievements and awarded him a second-place citation. He was approved as a "Zhu Ponuo [2612 0130 2032]-type cadre" and all comrades in the Air Force were called upon to study earnestly his advanced deeds and superior character so that construction of revolutionization, modernization and regularization of the Air Force is extended to a new level. The Air Force issued another general order on 8 June that awarded Jin Zhaoxun a second-place science and technology award for his participation in and leadership of the successful development a certain type of electronic interference aircraft and a second project.

Jin Zhaoxun joined the Air Force more than 30 years ago. He has a strong feeling of political responsibility and a firm dedication to the revolutionary cause. He is a no stranger to fatigue and dares to struggle. He has organized and participated in a total of 17 scientific and technological achievements and has been approved as an advanced worker and model CPC member many times, and he has received third-place awards on eight occasions.

#### I

All who know Jin Zhaoxun strongly admire his spirit of daring to struggle.

After entering the Air Force, Jin Zhaoxun participated in aviation aircraft service guarantee work for a long period. He noticed that the tools being used for maintenance were cumbersome and backward, so he boldly made technical renovations to improve and manufacture ultrasonic bearing cleaners and generator disassembly tools. This not only conserved aviation oil but also nearly quadrupled work efficiency.

Leading organs in the Air Force entrusted Jin Zhaoxun with leadership of a newly organized laboratory under a certain research institute in April 1977. This laboratory was responsible for development of electronic equipment. Before long, upper-level organs turned over a new refitting project to him and told him that "this may be a formidable task and it must be done well."

This refitting project touched upon multidisciplinary knowledge in such areas as electronic technologies, metal structures, aerodynamics and others. It was not just the technical complexity. The quality of the refitting was directly related to flight safety. Jin Zhaoxun and his comrades-in-arms carried experimental equipment and materials to the "furnace" Nanjing. The temperature at the time was 38 to 39 degrees. They set up shop in the spacious airport in temperatures higher than can be imagined. The physically weak Jin Zhaoxun worked during the daytime drilling into the aircraft to measure electrical circuits and to adjust and test its instruments. He could do nothing but wipe off his sweat-soaked clothes. At night, he ignored the mosquito bites, completely absorbed in his measurements, drawing diagrams and organizing data. Under Jin Zhaoxun's leadership, the comrades of the refitting group changed the local stipulation that they work a half day and rest a half day during the summer, working 12, 13 or more hours each day.

The sweat of their labor brought rich results. After more than 80 days, they had drawn more than 1,000 refitting diagrams and had added nearly 10,000 meters of wire leads and various complex instruments and equipment. Under the joint efforts of Jin Zhaoxun and his comrades, they finally completed a design for this refitting task and successfully refitted and energized it on the first try. The results of a trial during large-scale combat preparedness exercises by the entire Air Force proved that it was of excellent quality and met design requirements. It did a remarkable job of completing combat preparedness training tasks. Upper-level CPC committees awarded Jin Zhaoxun with a third-place prize.

## II

Jin Zhaoxun has inestimable fame among all those in the research institute, and they readily acknowledge his high scientific research and moral character.

Once, the upper levels assigned a actual responsibility for a refitting task to Feng Yingpu [7458 3841 3877], who still was a technician at the time. Because many new types of equipment had been installed on the aircraft, the original electric power source on the craft ran into problems. Feng Yingpu, who had returned to the military from being a propaganda cadre not long before, was in dire straits. Jin Zhaoxun encouraged him to dare to take responsibility for the task and worked day and night absorbing Chinese and foreign data. He proposed that a new type of electrical power system--a wind-powered generator installed on the aircraft--be developed for this type of aircraft refitting. He offered a comprehensive program to Feng Yingpu and also took Feng and other comrades to related departments for investigative research. Under Jin Zhaoxun's help and guidance, Feng Yingpu cooperated closely with a local research institute factory and with a certain Air Force military unit for successful joint development of China's first aircraft-installed wind-powered generator.

This achievement earned a second-place Air Force scientific research award. The Chinese Aviation Society paid close attention to the aircraft-installed wind-powered generator and asked Jin Zhaoxun and Feng Yingpu to present a paper at the society. Jin Zhaoxun helped Feng Yingpu to prepare an outline for the article and revised it several times, and he also let Feng Yingpu present it at the society.

Jin Zhaoxun has paid close attention to the growth of young S&T cadres in the laboratory. Assistant Engineer Tang Daoming [3282 6670 2494] had not attended an institution of higher education before entering the Air Force, so he felt that he was not suited to laboratory work. Jin Zhaoxun encouraged him to study hard and turned over an important development task to him, allowing him to develop his talents through practice. Jin Zhaoxun also bought him books on physics, chemistry, electricity, metallurgy and other subjects and helped him to formulate a study plan. After beginning the scientific research work, Jin Zhaoxun took Tang to visit the plant and also turned over his own already-summarized advanced testing methods to Tang. The warm assistance of Jin Zhaoxun caused Tang Daoming to make rapid progress. He not only understood and grasped general laws and methods used in scientific research work but also improved scientific research testing and inspection methods during practice. Later, after Tang had completed his research topic, Jin Zhaoxun also helped him make a conscientious summarization of his experiences and wrote three articles that were published in a Chinese scholarly journal.

12539  
CSO: 4008/399

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ORG: NI of Changchun Institute of Applied Chemistry, Chinese Academy of Sciences; TANG of the Polymer Materials and Engineering Department, Qingdao Institute of Chemical Engineering

TITLE: "Study of Synthesis of Amorphous 1,2-Polybutadiene Rubber.  
VII.  $\text{MoCl}_4\text{OC}_2\text{H}_1_7\text{-(i-Bu)}_2\text{AlOR}$  Catalyst System"

SOURCE: Lanzhou HECHENG XIANGJIAO GONGYE [SYNTHETIC RUBBER INDUSTRY]  
in Chinese Vol 8 No 2, Mar 85 pp 88-91

TEXT OF ENGLISH ABSTRACT: The behavior of the  $\text{MoCl}_4\text{OC}_2\text{H}_1_7\text{-(i-Bu)}_2\text{AlOR}$  catalyst system in the polymerization of butadiene is studied. The effect of the substitution group R in AlR<sub>3</sub> on the catalytic activity, the molecular weight and the microstructure of the polymer are examined. The results show that the larger the substitution group R is, the higher the catalytic activity and the more the 1,2-units in the polymer will be. When R is an aromatic group, the activity of the catalyst will be the highest. (Paper was received on 24 March 1984.)

AUTHOR: WANG Yurong [3769 3768 2837]  
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TITLE: "The Effect of Some Impurities Contained in Butadiene on the  
Synthesis of Medium Vinyl Polybutadiene Rubbers. III. The Effect of the  
Dimer of Butadiene on Polymerization"

SOURCE: Lanzhou HECHEM XIANGJIAO GONGYE [SYNTHETIC RUBBER INDUSTRY]  
in Chinese Vol 8 No 2, Mar 85 pp 92-95

TEXT OF ENGLISH ABSTRACT: The effects of the dimer contained in the butadiene monomer on the polymerization rate and conversion of butadiene, as well as on the microstructure, intrinsic viscosity and molecular weight distribution of the polymer, were investigated in a polymerization system with n-butyllithium (n-BuLi) as the initiator, tetrahydrofuran (THF) or diglycoldimethylether (2G) as additives, and cyclohexane as the solvent. It was found that the dimer affected neither the microstructure of the polymer (in the THF additive system), nor the molecular weight distribution or order dependence of the polymerization rate upon the monomer concentration. However, it did exhibit an effect on the conversion of butadiene and on the microstructure (in the 2G additive system), as well as on the intrinsic viscosity of the polymer and on the apparent activation energy for propagation. (Paper was received on 29 September 1982; edited version received on 14 June 1983.)

AUTHOR: HUANG Jingbin [7806 2417 1755]

ORG: Research and Design Institute, Carbon Black Industry, Zigong

TITLE: "Molecular Weight and Molecular Weight Distribution of Compounded Rubber Filled with Carbon Black"

SOURCE: Lanzhou HECHENG XIANGJIAO GONGYE [SYNTHETIC RUBBER INDUSTRY]  
in Chinese Vol 8 No 2, Mar 85 pp 108-113

TEXT OF ENGLISH ABSTRACT: The effects of carbon blacks with different tint strengths and tint residuals on the molecular weight and molecular weight distributions of compounded rubbers are investigated. The experimental results show that the low molecular weight fractions in the cis-1,4-polybutadiene rubber compounds are adsorbed on carbon black. In the rubber compounds filled with carbon blacks of negative tint residual, the free rubber has a narrower molecular weight distribution. The high molecular weight fraction of rubber in compounds is preferentially adsorbed by carbon black, but there is a limitation in the adsorption amount of very high molecular weight fractions because of the sieving effect of carbon black. It is found that the Kraus equation is merely applicable to the medium molecular weight range, whereas the Xu Dayi-Li Bincai equation is applicable to the high molecular weight range. The values calculated using the regression equations in the present study are in agreement with the experimental values from GPC studies. (Paper was received on 27 February 1984.)

9717

CSO: 4009/1096

AUTHOR: LIAO Mengyang [1675 1322 2254]

ORG: Wuhan University

TITLE: "Computer Analog Early Human Vision for Classification of Identical Multi-order Statistics Textures"

SOURCE: Wuhan WUHAN DAXUE XUEBAO (ZIRAN KEXUE BAN) [JOURNAL OF WUHAN UNIVERSITY (NATURAL SCIENCES EDITION)] in Chinese No 1, 1985 pp 55-61

TEXT OF ENGLISH ABSTRACT: A recent theory in vision science asserts that the information processing in early human vision can be modeled by a sequence of filters selective to certain bands of spatial frequency and orientation. In this paper, an attempt is made to use a computer analog vision system. The Gaussian pyramid algorithm is used for spatial frequency filters. Several feature-extraction operations of different orientations have been selected to be regarded as masks. Identical multi-order statistics texture pairs generated by the computer have been experimented with according to the Fisher linear discriminant. The classification accuracies obtained are greater than 93 percent, thus indicating better matching.

AUTHOR: YU Zirong [0205 1311 2837]  
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TITLE: "Design and Implementation of Bus Switch Interface in Distributed Microcomputer System"

SOURCE: Beijing WEIJISUANJI YINGYONG [MICROCOMPUTER APPLICATIONS] in Chinese Vol 6, No 2, Mar 85 pp 37-41

ABSTRACT: A key problem in distributed microcomputer systems is computer-to-computer communication. If the communication bit rate is required to be 1 MB/s, the application of a common storage area is a simple, feasible method for 1-to-1 or 1-to-N communication between computers. The bus switch interface is a common storage area for two or more computers with control circuits and software for orderly execution of data communication among these computers. This system can expand a microcomputer system into a single-board computer. The authors made a printed circuit board (with circuits and program of bus switch interface) to be plugged in CROMENCO-III microcomputer system, which is connected to a TP-801 or TK-85 single-board computer. These two computers can operate together. This technique is useful in China as there are many users for TP-801 and CROMENCO-III computers. The No 201 Teaching Research Laboratory of the Beijing Aeronautical Engineering College has successfully developed hardware and software for bus switch interfaces. Eleven figures show the common internal storage, single communication buffer storage, structure and principle of two storage buffers, data bridging structure, dual-direction bridging logic, control circuit logic, address logic, compilation logic, circuit logic for interruption and exchange of signals, and debugging flowchart. The authors express their thanks to Wang Gonghao [3769 0361 8504], Chen Ruilin [7115 3843 2651], Cao Yong [2580 0516] and Yu Tanwei [0151 5917 3555] for taking part in discussions and experiments.

10424  
CSO: 4009/1110

AUTHOR: LI Zeming [2621 1869 6900]

ORG: The Fifth Research Institute, Ministry of Posts and Telecommunications

TITLE: "Application of Microcomputers in Cable Pressure Telemetry System"

SOURCE: Beijing WEIJISUANJI YINGYONG [MICROCOMPUTER APPLICATIONS] in Chinese  
Vol 6, No 2, Mar 85 pp 55-58, 54

ABSTRACT: Currently in most gas pressure maintenance systems of communications cables, a low gas pressure alarming device is installed, triggering an alarm when the pressure drops below a preset value. Such a system cannot sense the gas pressure of all points along the cable, therefore much work is required to locate the gas leakage point. The cable pressure telemetry system presented in the paper can obtain accurate, continuous data of gas pressures along the cable through pressure signal devices (transmitters) installed at points along the cable by using a TP-801 single-board computer with a microprinter. At a certain distance along the cable (for example, 2 km), a gas pressure signal device and a time lag control circuit are installed. When a start signal along a cable is initiated, an electrical simulation signal is transmitted to the terminal. After the No 1 device completes its transmission, the No 2 device takes up the transmission, and then No 3, No 4, .... The time difference of transmission between two adjacent signal devices is in the tens to hundreds of milliseconds. The printout shows gas pressures at points along the cable. Matched with an input interface circuit, the malfunctioning of a particular signal device can be determined. A period of only about 10 seconds is required for checking gas pressure values along a cable about 110 km long. The pressure distribution curve thus recorded is valuable in the accurate location of leakages. Four figures show the system's operating principle, input port, and flowcharts of data input sequence and binary-to-decimal conversion subroutine. The cable pressure telemetry system has been line-tested.

10424

CSO: 4009/1110

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TITLE: "An Optical Parametric Oscillator (OPO) Tunable in  $1.47 \sim 4 \mu\text{m}$ "

SOURCE: Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 5 No 7, Jul 85 pp 590-593

TEXT OF ENGLISH ABSTRACT: IR intracavity optical parametric oscillation is obtained by using an electro-optic Q-switched Nd:YAG laser as the pumping source and a 50°-cut LiNbO<sub>3</sub> crystal as the oscillator. The wavelength is tuned by varying the temperature of LiNbO<sub>3</sub>. The tunable range is  $1.47 \sim 4 \mu\text{m}$ , with output energy over 100  $\mu\text{J}$  per pulse and linewidth less than  $5 \text{ cm}^{-1}$ . This OPO has been applied to laser chemistry with good experimental results.

AUTHOR: CHEN Xingdan [7115 2502 2481]

ORG: Changchun Institute of Optics and Fine Mechanics, Chinese Academy of Sciences

TITLE: "Measurement of Reflection and Scattering of Mirrors in the VUV and Soft X-ray Region Using Synchrotron Radiation"

SOURCE: Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in English Vol 5 No 7, Jul 85 pp 605-608

TEXT OF ENGLISH ABSTRACT: The design and calibration of a soft X-ray telescope and synchrotron radiation monochromator require a knowledge of the optical properties of a mirror surface for various mirror materials over a fairly wide range of grazing angles and photon energy. For this purpose, the reflection and angle resolved scattering curves of four mirror samples (fused quartz, optical glass, zerodur and electroless nickel) were measured in the photon energy region of from 0.1 to 1 keV at grazing angles from  $0.6^\circ$  to  $30^\circ$ . The measurement was carried out at beam line 11 and is mainly used for the Baker grasshopper monochromator and PF reflectometer. All the samples were polished by Changchun Institute of Optics and Fine Mechanics (CIOM). The rms roughness of the sample surface was measured by the stylus method at the National Laboratory for High Energy Physics (KEK) and CIOM successively. This was in the order of 1 nm. The electroless nickel sample was formed by plating an aluminum disk with Kanigen. Part of the results shown are of electroless nickel which is used more often as a mirror material in soft X-ray telescopes and synchrotron radiation monochromators.

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TITLE: "Selection of KDP Doubling Crystals with High Conversion Efficiencies"

SOURCE: Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 5 No 7, Jul 85 pp 614-618

TEXT OF ENGLISH ABSTRACT: The inherent external mismatching angle is used to represent the phase mismatching caused by inhomogeneity in refractive indices of doubling crystals. A new method is presented that can measure this important parameter accurately. The small-signal conversion efficiency is measured under a laser intensity of about  $20 \text{ MW/cm}^2$ . A reference KDP crystal is used to eliminate laser-induced fluctuations. The experimental data are compared with theory in determining the mismatching angle of the crystals,  $\Delta\theta_c$ . Among doubling crystals, those with high conversion efficiencies can thus be selected readily. For some of them, the high conversion efficiencies have been born out experimentally.

9717  
CSO: 4009/287

AUTHOR: SUN Zongjian [1327 1350 1696]  
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TITLE: "Determination of Propagation Coefficient for Scalar Modes in Optical Fiber"  
SOURCE: Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 5 No 7, Jul 85 p 653

ABSTRACT: In the paper it is reported that using a prism-fiber coupler, the propagation coefficient  $\beta_{mn}$  for scalar modes traveling in optical fiber can be determined by measuring coupling angles or positions of m-lines. Each scalar mode can be excited by varying the coupling angle. The so-called m-line corresponding to each scalar mode is coupled out of an output prism. Its characteristics are different from those of the m-line coupled out of a planar waveguide. The degeneration of  $\beta_{mn}$  is shown on the m-line photograph. A good agreement is obtained between the measured and calculated values of  $\beta_{mn}$ . (Paper received 29 October 1984; revised 12 February 1985.)

AUTHOR: WANG Zhaomin [3769 0340 3046]  
ORG: Department of Optical Physics, College of Optical and Fine Mechanics, Changchun  
TITLE: "Stimulated Raman Scattering of a New Raman Gain Medium--N<sub>2</sub>-in-Silica Fiber"  
SOURCE: Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 5 No 7, Jul 85 p 657

ABSTRACT: A measuring method of the stimulated Raman scattering (SRS) of diffused N<sub>2</sub> in solid silica optical fiber is proposed. It is a new type of Raman gain medium--gas in glass. The dependence of threshold and linewidth of SRS on the power of pump light is discussed. The output mode is measured when the transmission wavelength in the optical fiber is lower than the cut-off wavelength of the single mode silica optical fiber. In addition a weak coupling mode between N<sub>2</sub> and SiO<sub>2</sub> molecules is observed in the experiment.

CSO: 4009/1104

AUTHOR: LIU Dehai [0491 1795 3189]  
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et al.

ORG: Wuhan University

TITLE: "Studies on Organomolybdenum and Tungsten Compounds. II. Catalytic Polymerization of Alkyne by Metal-Carbene of Molybdenum(o) and Tungsten(o)"

SOURCE: Wuhan WUHAN DAXUE XUEBAO (ZIRAN KEXUE BAN) [JOURNAL OF WUHAN UNIVERSITY (NATURAL SCIENCES EDITION)] in Chinese No 1, 1985 pp 71-76

TEXT OF ENGLISH ABSTRACT: The catalytic polymerization of alkyne in the presence of the metal-carbene of  $[(CO)_5W = C(OEt)R]$  and the catalytic systems  $[(CO)_5Mo-C(O)R]N(CH_3)_4 + Et_3OBF_4$  ( $R = \text{S-C}_6H_4-$ ,  $O-C_6H_4-$ ,  $C_6H_4-$ ,  $CH_3-$ )

has been studied. The results show that these complexes have catalytic activity for the polymerization of monosubstituted acetylene. In the metal-carbene complexes  $(Co)_5M = C(OEt)R$  ( $M = W, Mo$ ), catalytic activity of the substituting group R in the polymerization of phenylacetylene was found in the following order:



In addition, The catalytic polymerization of phenylacetylene under various conditions was also studied.

Physical Chemistry

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ORG: Wuhan University

TITLE: "Hydrated Lanthanum Hydroxide Bromides and Their Crystal Structural Analysis"

SOURCE: Wuhan WUHAN DAXUE XUEBAO (ZIRAN KEXUE BAN) [JOURNAL OF WUHAN UNIVERSITY (NATURAL SCIENCES EDITION)] in Chinese No 1, 1985 pp 77-84

TEXT OF ENGLISH ABSTRACT: The  $\text{La}(\text{OH})_2\text{Br} \cdot 1.5\text{H}_2\text{O}$  and  $\text{La}(\text{OH})_2\text{Br} \cdot \text{H}_2\text{O}$  were obtained under ordinary temperature and pressure by the lanthanum oxybromide reacting with water or water vapor respectively, and the  $\text{La}(\text{OH})_2\text{Br}$  was obtained by heating  $\text{La}(\text{OH})_2\text{Br} \cdot 1.5\text{H}_2\text{O}$  or  $\text{La}(\text{OH})_2\text{Br} \cdot \text{H}_2\text{O}$  at 120-140°C. The thermal decomposition processes and crystal structures of these compounds were investigated by using DTA, TGA and powder X-ray diffraction methods. The  $\text{La}(\text{OH})_2\text{Br} \cdot 1.5\text{H}_2\text{O}$  loses one crystal water at 108-140°C and half a crystal water at 140-210°C, but the  $\text{La}(\text{OH})_2\text{Br} \cdot \text{H}_2\text{O}$  loses crystal water at 125-226°C, to form  $\text{La}(\text{OH})_2\text{Br}$ . Then the  $\text{La}(\text{OH})_2\text{Br}$  decomposes thermally at 310-390°C under the  $\text{N}_2$  stream to form  $\text{LaOBr}$ . The  $\text{La}(\text{OH})_2\text{Br} \cdot 1.5\text{H}_2\text{O}$  forms hexagonal crystals with  $a = 8.4350 \text{ \AA}$ ,  $c = 4.2302 \text{ \AA}$ , and  $Z = 2$ . The  $\text{La}(\text{OH})_2\text{Br} \cdot \text{H}_2\text{O}$  forms orthorhombic crystals with  $a = 12.635 \text{ \AA}$ ,  $b = 5.023 \text{ \AA}$ ,  $c = 17.275 \text{ \AA}$ , and  $Z = 10$ . The  $\text{La}(\text{OH})_2\text{Br}$  forms monoclinic crystals with  $a = 6.3742 \text{ \AA}$ ,  $b = 4.0306 \text{ \AA}$ ,  $c = 7.1599 \text{ \AA}$ ,  $\beta = 113.121^\circ$ , and  $Z = 2$ . The IR spectra of these compounds were determined and discussed.

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